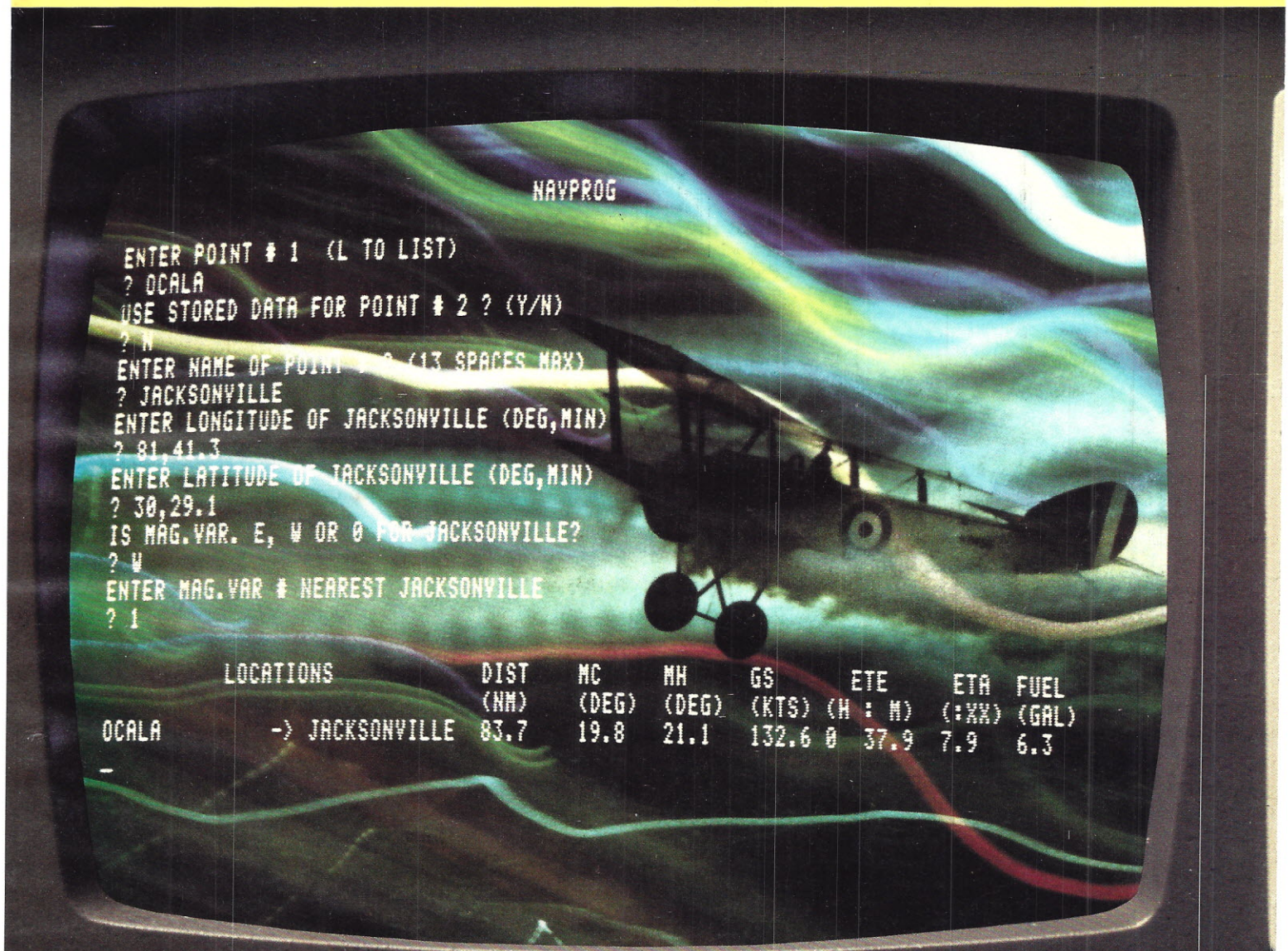
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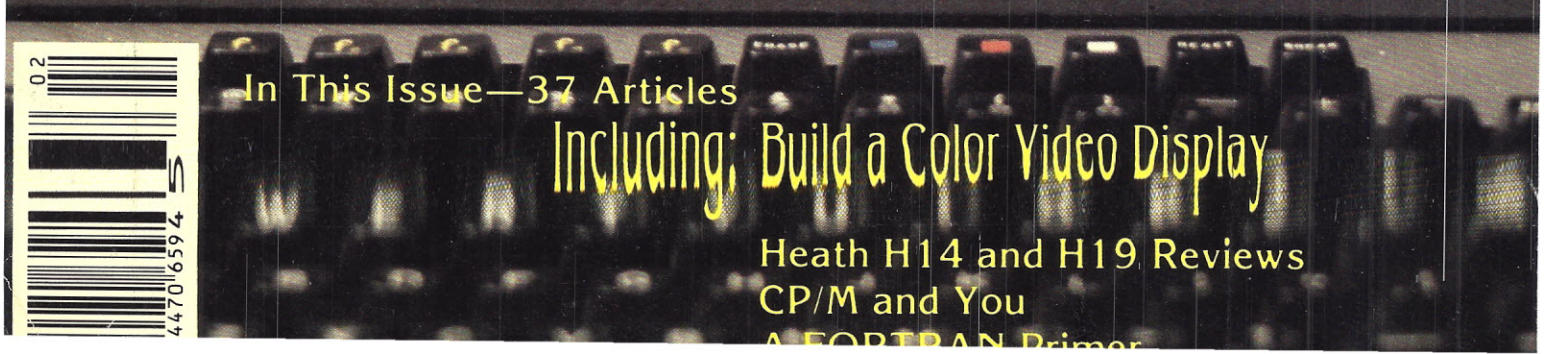
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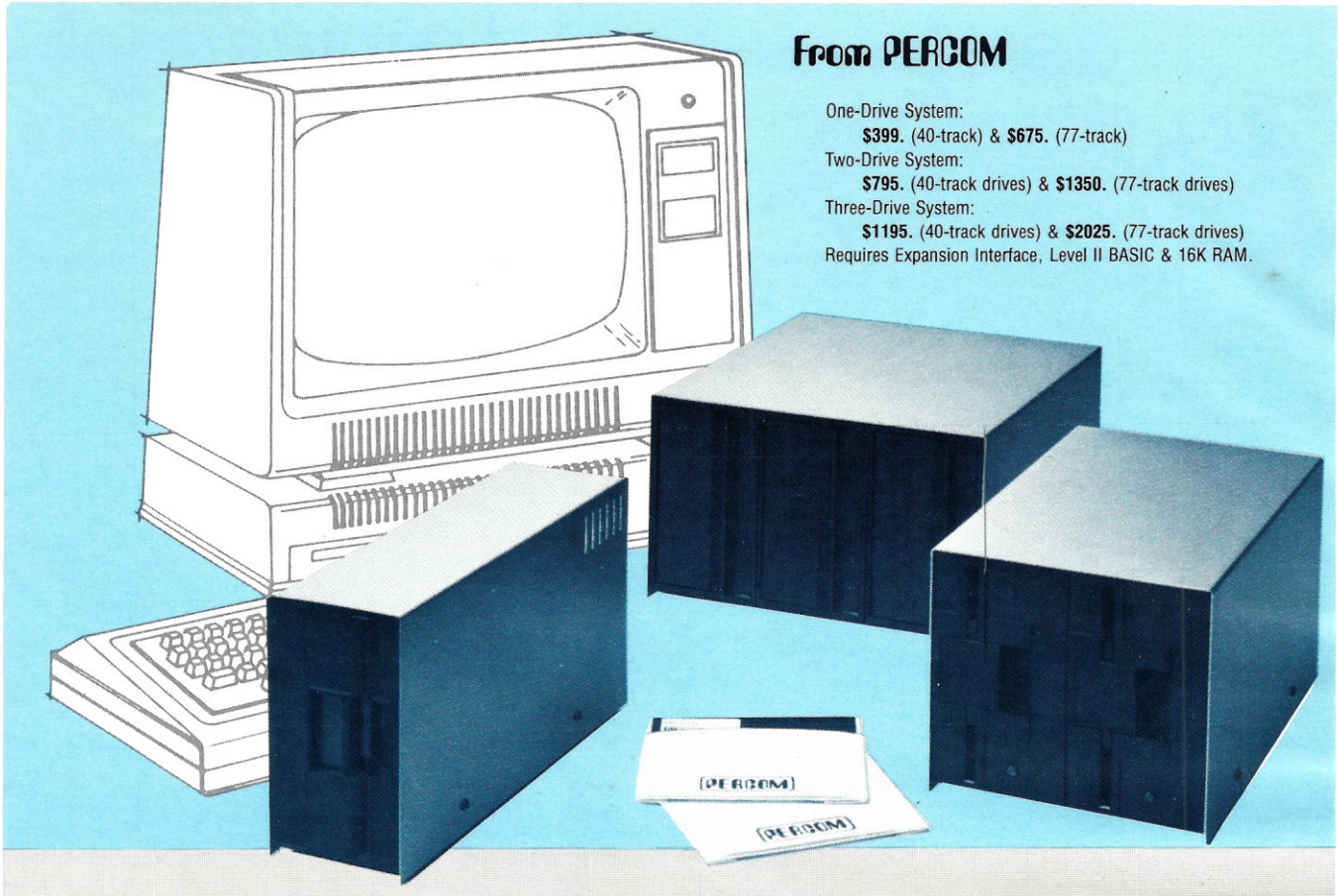
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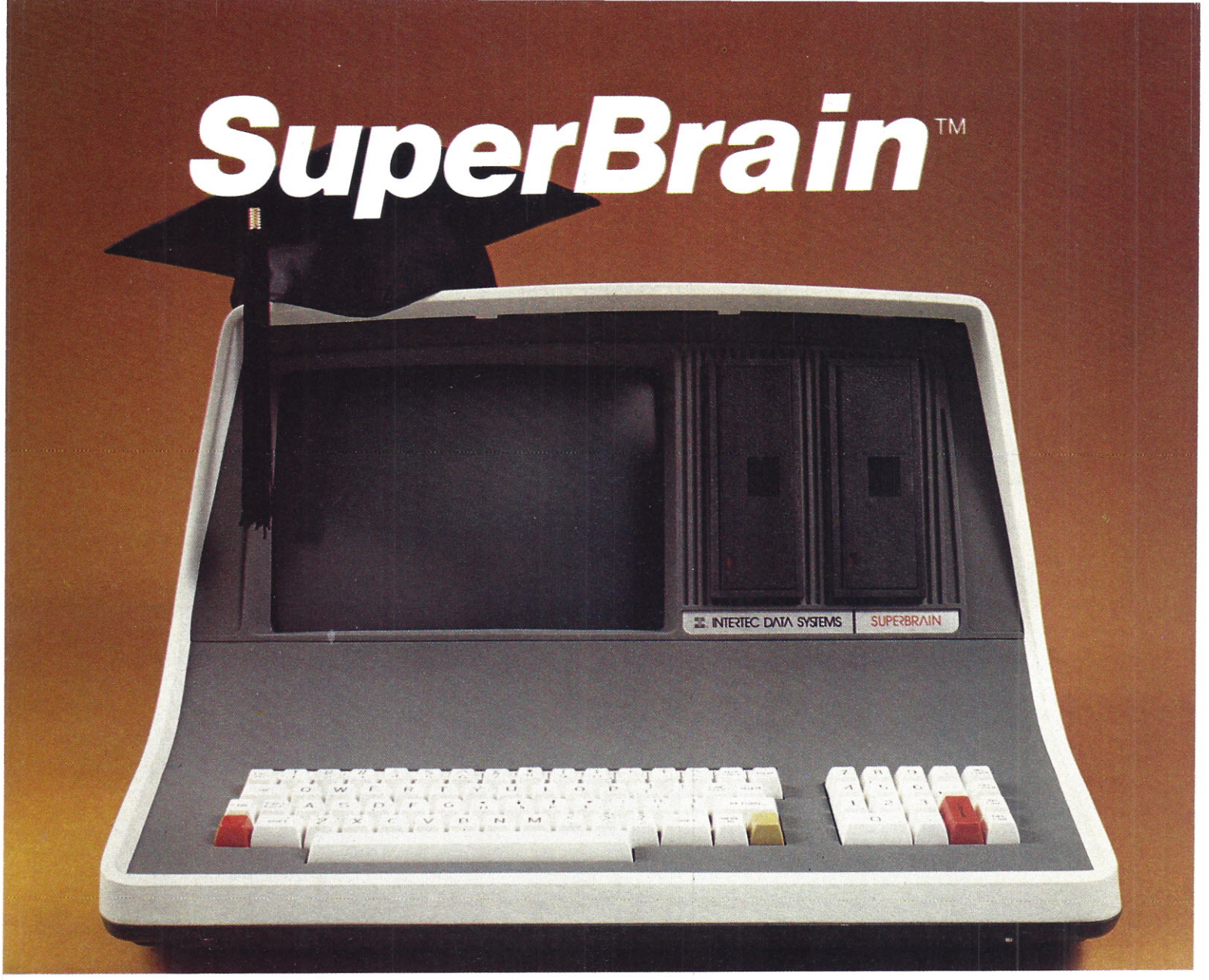
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micro info

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PUBLISHER'S REMARKS

Wayne Green

Centronics Does it

In early November I got a cryptic note from Centronics announcing a press conference in Boston for a new printer. I think all of us present were excited by the presentation.

Centronics unveiled their Quietwriter, and it was something completely new in writing systems. Before this, Centronics had been famous for dot-matrix printers. They had also produced some excellent treated paper printers. The two ways of putting characters on paper by printers so far had been via an impact system, with a ball, type wheel and dot matrix, or via treated paper and an electrical discharge. Now there was a new system. It was much like having a typewriter operate a pen against the paper.

The heart of the new print mechanism contained few moving parts. It had a stylus, which pressed a carbon ribbon against the paper. The stylus moved up or down, or increased in pressure by means of voice-coil operated levers. The movements of the stylus were programmed by a ROM and a microprocessor. One could type in English, Russian, Arabic, Farsi or even Chinese characters, just by changing the ROM. The pen could even imitate handwriting.

The prototype Quietwriters (and they were very quiet since there was no impact involved) turned out most attractive type.



The newly announced Centronic Quietwriter is still perhaps 18 months away from regular production. It is a completely new type of writer, using a stylus, much like a pen, to write. The cartridge holds the ROMs, which control the position of the stylus for each alphabet, whether it be English, Arabic or Chinese. The controls on the left govern the size of the character, boldness, slant, etc.

The announcement was made about 18 months before production was scheduled, apparently for some legal reasons.

It is still too early for Centronics to make any firm commitments on the price, but it might be around $1000. Since the printer obviously will interface with microcomputers and be a wonder for word processing and electronic mail, I was ready to sign up for a few if a dotted line had been flashed.

Centronics is a good parent for this new system. It is the largest computer-printer firm, with sales last year of over $120 million. They've already sold over 150,000 printers, so they know design, production and marketing.

Out of Work

I've watched many union strikes trying to prevent automation. Yet studies have shown that the long-term results of industrialization and automation have increased the number of jobs and made higher wages possible. The middle class came into its own as a result of the industrial revolution.

My visions of teaching machines make some teachers irritated and panicky. While my concept of learning via teaching machines could move most of the present-day studying into the home, I don't think it would reduce the need for trained teachers. It would, I'm sure, make life a lot more enjoyable for them by removing much of the present-day drudgery of teaching.

My concept is for the development of a combination videotape recorder and microcomputer system. The more common subjects such as arithmetic, geography, history, languages, physics and chemistry would be taught largely by these machines using full color movies . . . like the Nova series on Public Broadcasting. Each course would be taught by top people in the field, and it would be so interesting that a student would learn because it was fun and exciting, not because the student had been forced into class by law. The program would explain the subject, stopping every now and then to question the student. If there was an area of misunderstanding, the tape would go back to the problem area and show it again . . . or could even go quickly to another place on the tape and give more details for slow learners.

A teaching machine system would be geared to the speed of the student and would have infinite patience. It would quickly



The stylus is positioned per the instructions in the ROM by voice-coil-type action both vertically and horizontally. A third voice-coil controls the strength of the impression, making it possible to have from thin to heavy lines. Since the stylus writes like a ball-point pen, it is possible to make a program which will allow it to do regular handwriting.

Centronics Quietwriter Sample

Centronics Quietwriter Sample

Centronics Quietwriter Sample

Centronics Quietwriter Sample

Centronics Quietwriter Sample

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发奋友幸电 电幸友奋发 奋友幸电发

Here we see the different sizes of type possible . . . plus a sample of Arabic and Chinese writing.

obsolete present teaching systems where large groups of students all have to progress at the rate set by the slowest student in the class.

With courses designed to interest and entertain, I think most students would cover many times the material they can today. Any special interests could be catered to.

I envision a time when most of the courses presently taught in grammar school, high school and college will be developed for these teaching systems. If you think of it, a cost of $1 million or more for a single course will be inexpensive when the course will be used by millions of children. Once the courses are prepared, why can't we translate them into all other languages and use them to educate the entire world? One teaching course could be used by students everywhere.

This projection has turned teachers ashen. If all that teaching were done by computerized systems, where would teachers fit in?

I think we'll need more teachers than ever to cope with the educational needs of the future. I also think that the role of most teachers will be a bit different. But first, I think it is obvious that no matter how well crafted, a program is going to bring up student questions that will require individual attention. A question generally stops all further progress until it is answered.

My idea for handling this situation is a two-way television circuit built into the teaching machine, probably through cable television or satellite direct communications. This would allow the student to access a teacher and discuss the problem. I suspect that one teacher could field questions from many students, particularly if the teacher specialized in one or two fields. With modern communications, teachers could have their "studio" anywhere.

I think there are definite limits to what can or cannot be taught via a video system, no matter how good it is. Students will still have to experience doing things. They will want to learn how to use tools. All of these things require some computerized educational time, some personal instruction and a lot of practice with the hardware.

The teacher of the future, as I view it, will be kept busy educating students in these physical things. We may split our days or weeks into parts so students can use hardware on a rotating basis . . . one or two days a week with a teacher and the lab work and the rest at the teaching machine, for example. This will allow everyone to learn more than is possible today, and as the list of skills being taught by teachers grows, so will the need for these teachers.

You *Can* Win at Craps!

I've been following most of the many books published on how to win at gambling games. Oddly enough, many are interesting and can be helpful. Anyone with some interest and the will to learn how can win at gambling and, at least until he is recognized by the casinos, make a good living at it. Casinos are business enterprises and are not amused by steady winners, so one's welcome wears out quickly.

An integral part of the "system" for beating the casinos lies in your computer. You don't have to bring it with you or hook up one that will operate from your pocket. You have to learn how to gamble effectively and then practice with your computer until you have it down pat. It will take a good deal of practice, and you'll want to use one of our Instant Software Casino packages, which is a reconstruction of casino gambling.

You're impatient for the nitty-gritty, right? Obviously there is a secret involved; otherwise, people would be winning regularly at Vegas, which very few are. It takes a lot of losers to build those giant light extravaganzas designed to lure you into gambling dens. The streets of Vegas are paved with gold . . . yours.

The "system" for winning can be applied to any of the games at Vegas, but since the fastest game is craps—and it is also the one that has a bet that is least beneficial for the house, this is your best bet.

There are dozens of systems for betting at craps, and all have many believers. The systems have one factor in common: not one is foolproof. Most of them are based on starting small and doubling up when you lose a bet. The house has already thought of this and conveniently placed a limit on how much you can bet at one time, a level which, unfortunately, most systems quickly reach when the laws of chance momentarily seem suspended against you.

One book goes deeply into the mathematics of gambling: *Casino Gambling—Why You Win/ Why You Lose* by Russell Barnhart. It sells for $12.95 and is worth it. This book carefully examines all of the popular gambling systems: the paroli, the great paroli, the martingale, the great martingale, Labouchere and reverse Labouchere, Bethell, D'Alembert, Cover, Blundell, Ascot, Fitzroy. They are *all* losers in casinos.

To win at gambling, first familiarize yourself with the odds you are against. The house has no bets even slightly in your favor, but there are many variations in the odds—and there is a factor we think of as *luck*. Let's first look for the bets that give you the lowest odds for the house; then we'll look at how you can use "luck" to your advantage.

I know you'll find this difficult to believe, but the familiar craps game layout is deceptive. As you look at it from the standpoint of odds you'll find that the larger the betting area and numbers, the worse the odds. The better odds are barely visible on the layout, and the best odds are not even indicated. These are the Lay The Odds and Take The Odds bets, which can bring your chances up to less than one percent against you. The Take The Odds bet leaves the house with a 0.85 percent advantage and the Lay The Odds bet is even lower at 0.83 percent against you. It doesn't take much manipulation of luck to overcome this tiny advantage.

That is the basic secret of winning at gambling: knowing the best odds and understanding how luck works and using it to win.

Once you are familiar with the actual odds in craps you'll be amazed at the number of supposedly educated gamblers who make stupid bets. Some of those seemingly innocuous bets on the layout have better than a 16 percent advantage for the house. You'll keep the odds down best if you start with the normal Pass bet and then double it up with the Take The Odds bet. This gives the house only a 0.85 percent advantage. If you ignore luck entirely and just keep betting, you'll get the most play for your money with this combination before ending up broke.

With the Pass bet you win right away if a natural, 7 or 11, is thrown. You lose if it's craps: a 2, 3 or 12. Otherwise, you win if the thrower makes his point and lose if he does not. To make this bet you place your money in the Pass space, along the bottom.

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The Take The Odds bet can be made if the thrower gets a point rather than throwing a natural or craps. Then you can double your Pass bet, placing the additional chips just outside the Pass box. If you win at this you get the actual odds from the house—a 50/50 proposition—and the only such you can get in this game. This reduces the odds against you from 1.41 percent on the play to 0.85 percent. The casino game on your computer should permit this type of bet; I know the Instant Software version does.

Let's take a look at luck. If you don't believe in luck then you've never gambled or played cards. There *is* luck and, more important for us, it runs in streaks. If you spend much time playing or even watching craps (or any other game), you'll notice that the table will run "hot" for a while and then run "cold." At other times nothing much seems to happen one way or the other, then suddenly the house will begin to win in a long string of throws as the table is cold. A while later a player or even a stream of players will be able to do no wrong, with passes mounting as high as ten or even fifteen before a craps. It is runs like this that devastate all the systems of increasing bets.

In the long run, all evens out. There will probably be at least one run of 15 straight passes or craps every two or three months, and you can expect a run of ten around once a day . . . not bad odds unless it happens while you are doing the doubling up.

Thus the winning strategy is to play it cool. Watch the tables and wait until one heats up—then bet modestly, taking the odds each time, counting on the run of luck to counter the slight mathematical odds against you. You may want to increase your bets as you win, using the simple paroli system (1+2+4+8+16+32, etc.), a binary growth system.

The foolish way to attack this is to take your money to Vegas and practice there . . . at *your* expense. Your computer can be a lifesaver. Set it up with the Casino program and start keeping track of the dice rolls, until you can sense when the dice are hot and when they are cold. Practice making your bets until you can consistently beat the game on your computer. Only when you are familiar enough with playing this system that you never lose are you ready to tackle the casinos.

You should move around from casino to casino, not wearing out your welcome as you gather a thousand here, a thousand there.

Help Wanted

Nathaniel Hawthorne College is looking for someone to head its new microcomputing program. The college is putting together a complete microcomputing degree course and will need a top organizer, with teaching credentials, and instructors, all with extensive microcomputing experience.

Hawthorne, a private college in Antrim NH, is famed for its aeronautics curriculum.

A college that teaches flying, and now microcomputing, is a great place to work. If you are interested and have the background, drop a resume to Dean of Administration Merle A. Jones, Jr, Nathaniel Hawthorne College, Antrim NH 03440. He's anxious to start, so don't procrastinate.

OUTPUT FROM ISI

Sherry Smythe

Reps

A "rep" is a person who is in business for himself as a free agent and represents a manufacturer as a local salesman in his specific territory.

In the case of Instant Software, this means there is a person whose job it is to visit every retailer of computers on a regular basis. This person makes sure that the store owner and salemen are aware of the latest in software packages and how to demonstrate and sell them. The rep helps set up displays, answer questions, provide guidance on sales techniques; expedites orders; solves problems and makes sure our software, books and magazines are in plentiful supply and prominently displayed. This takes a lot of work off the shoulders of the store owner and puts us in close touch with what is happening.

These reps have been coming from all over the country to the Instant Software lab in Peterborough for training on the systems running there. Reps learn about the more popular ISI program packages, how they work and how to demonstrate them. They take a course in the history of and projections for microcomputer hardware and software.

These are difficult times for computer stores. Few have either the time or the background to sit down and test every software package on the market. There isn't even time to thoroughly check out the better advertised business packages. This means that stores either have to take chances that can hurt their reputations, or else they have to find a dependable software firm. The alternative to this mess is dealing with a firm that is not only completely dependable, but that has representatives coming to call to help with problems, should they arise.

Software Sought

While all of the programs so far published by ISI have been in cassette format, disk format programs are being readied for distribution. Programmers with disk-based programs are being encouraged to submit programs.

We're looking for a lot more material for the Apple. You Apple people should assure it that the Apple is supported with programs, particularly business programs. That full-color facility can be put to excellent use in business.

Another gold mine for programmers lies in utilities. Some of those programs you worked out for your own use just might, with some debugging and detail work, plus documentation, make your hobby pay for itself.

In deciding which software publisher can do the best for you, remember that the sales of your program depend on the reputation of the publisher and his distribution network.

BOOK REVIEWS

Software Interpreters for Microcomputers

Thomas C. McIntire
John Wiley & Sons, New York
233 pages, $18.95

If you have always had an uneasy feeling about that "thing" in your computer referred to as an "interpreter," this book will allay your fear that something magical is happening inside. On the other hand, if you think your computer speaks BASIC as its native language, you may find this book unwieldy. This does not mean the text is difficult to follow. As a new term is given the author defines the meaning so you do not become so swamped with terminology the concept becomes obscure.

Interpreter is defined on page 1 as "a software routine that, as processing progresses, translates a stored program expressed in pseudo-code into machine code and executes the intended operations." To expand on this definition, the author describes how an interpreter differs from a compiler, and the advantages and disadvantages of each.

By the end of chapter 1, the concept is clear. Chapters 2 and 3 delve into the evolution of the microcomputers and languages associated with them. Chapters 1 through 3 comprise the background needed to understand the necessary parts of interpreters.

Interpreter architecture is the next major topic. It deals with interpreter types and storage requirements. The next two sections deal with the interpreter design approach and design model. The word "design" is important because this is not a cookbook for writing an interpreter, but rather

what you should be aware of when designing one. The basic skeletal structure is discussed, and some general flowcharts are provided to itemize the major decision blocks needed to parse BASIC. However, no specific code is given. The last section covers some "tricks of the trade" in terms of optimizing execution speed and memory utilization.

Those who have spent hours writing and debugging programs know that a lot of work goes into the program that is not obvious to the person using it. The interpreter is doing a lot of work for you as you write and run your program. Sometimes what you don't know can cause you to tear your hair out if the gremlins of an interpreter make themselves known. More ingenious (devious) programmers can turn these quirks into a useful tool, but don't depend on the quirks to work with another interpreter!

I would like to have seen included in this book a well-annotated 4K 8080 or Z-80 assembly listing showing how to go from the general design to the actual code to accomplish the specific tasks. Many concepts can be grasped theoretically, but at a nitty-gritty level, understanding can fade quickly!

I recommend this book to anyone who wants a better understanding of what an interpreter is and what it does. *Software Interpreters* is quite readable for those with a basic grasp of a programming language. If you are going to write an interpreter, you can save a lot of grief by knowing the design considerations beforehand.

Jerry Martin
Columbus OH

Programming the 6502

Rodnay Zaks, Sybex, Inc.
Berkeley CA, 1978, $11.95

Editors' note: Here's another look at Programming the 6502, *which was originally reviewed in the July 1979 issue.*

First, the bad news! *Programming the 6502* is full of mistakes. There are about 150 of them in the book's 300 pages. The errata sheet, included with the book since May 1979, lists about half of these errors, but even it has some errors! Worse yet, the majority of the mistakes are not simple typos—many are extensive, subtle and misleading or untrue "facts" about the 6502, which might only be discovered by a careful reader experienced with the 6502. Since the book was written primarily for the novice programmer, this presents a special problem.

Rodnay Zaks has written excellent books in the past, such as *Microprocessor from Chips to Systems* and *Microprocessor Interfacing Techniques* (coauthored by Austin Lesea), both of which contained typos, but not the more serious errors found in *Programming the 6502*. Apparently, both Mr. Zaks and the publisher were in a hurry to cash in on the growing popularity of the 6502 and skimped on research and proofreading.

Now for the good news . . . well, at least the better news. The book is organized into eleven chapters and six appendices. It contains a broad coverage of microcomputer programming, and 6502 programming in particular, but most subjects are treated briefly. Since the book was aimed at the newcomer to programming, this might have been expected. However, in some areas, I felt a more detailed treatment would have been helpful. Exercises sprinkled throughout the book are helpful to the reader if he attempts them.

In chapter 1 ("Basic Concepts") the basics of programming are discussed, along with the internal and external representation of data. Number systems and computer arithmetic are treated very briefly. Due to the importance of these topics to machine- and assembly-level programming (which is what this book is about), a more in-depth coverage here would have been helpful.

Chapter 2 ("6502 Hardware Organization") covers the hardware aspects of the 6502 that the programmer needs to know. It is brief but adequate. Included are system architecture, internal register structure and the instruction execution mechanism.

Chapter 3 ("Basic Programming Techniques") covers arithmetic and logical operations and subroutines. Single- and multiple-precision addition and subtraction in both binary and BCD are covered in detail with good examples. Also, multiplication is explained with a couple of well-documented and clever programs. This is one of the better chapters.

Chapter 4 ("The 6502 Instruction Set") first discusses instruction sets, in general, with a good description of useful but usually unavailable instructions, and then discusses the 6502 instruction set. Included in this chapter is a page or more on each separate instruction. The discussion of the BIT and CMP instructions is not adequate and may leave one confused about these instructions.

Chapter 5 ("Addressing Techniques") superficially covers the addressing modes of the 6502. The 6502 shines with 13 addressing modes, and a better treatment of this subject is needed. Worse yet, the already confusing indirect-indexed and indexed-indirect modes are further confused by the author, who gives no example of the indexed-indirect mode (although one example was incorrectly proposed to be for this mode). There was adequate information on the other modes.

Chapter 6 ("Input-Output Techniques") is one of the better chapters. In most cases, it shows both hardware and software approaches to a problem and discusses the trade-offs involved. Topics covered include pulse generation and detection, delays, parallel and serial data transfers, polling, handshaking, LED interfacing, Teletype I/O, interrupts and the BREAK instruction usage. The main fault in this chapter is under the topic of Simultaneous Interrupts. This subject is not discussed—in fact, this subject is not covered at all. Instead, the topic is multiple or nested interrupts, and lacks in detail at that.

Chapter 7 ("Input/Output Devices") discusses the various support chips in the 6502 family. It only mentions four of them and details only the 6520 PIO. An entire book could be devoted to each of the support devices, but this chapter only allows eight pages for all of them . . . need I say more?

Chapter 8 ("Application Examples") contains about a dozen "utility routines" or short useful programs with explanations. Some are rather clever, all make good examples; but a few are not explained well enough. Examples of the routines are: pulling I/O devices, character input, parity generation, code conversion and finding the largest element of a table.

Chapter 9 ("Data Structures") gives a brief but probably adequate treatment for the beginning programmer of pointers, sequential lists, directories, linked lists, queues, stacks, blocks, circular lists, trees, searching and sorting.

Chapter 10 ("Program Development") provides a good treatment of the program development process. It discusses machine-language, assembly language and high-level languages, and assemblers, compilers, editors, loaders and debuggers. It covers the actual program development sequence, the various hardware alternatives (single-board microcomputers, hobby-type microcomputers, time-sharing systems) and then goes into a more detailed treatment of an assembler and the assembly process, including macros and conditional assembly.

Chapter 11 ("Conclusion") is nothing more than a couple of pages of closing comments. There are also six appendices with some rather useful charts on the instruction set, ASCII code and relative branching.

I have been quite critical of *Programming the 6502*. The major drawback is the unbelievable number of errors and the lack of detail in some important areas. I wouldn't recommend it to a novice programmer. A person familiar with the 6502 is bound to learn something from it, and it is challenging, although irritating, to try to find all the errors. With all the corrections made, it would be a useful book, but certainly not the long-awaited answer to the 6502 programmer's dreams.

Jerry Petrey
Ontario CA

BASIC with Business Applications

Richard W. Lott
John Wiley & Sons
New York

This introductory BASIC text is written with time-sharing users in mind. I get the impression that the examples were run on a DEC computer, but this doesn't really matter. Virtually everything in the book can be run unchanged by the average BASIC-speaking personal-computer system.

The book is divided into two parts. The first is a fairly conventional introduction to BASIC which presents all the major statements in the language and introduces elementary programming structures such as loops. The second part is a series of sample programs and problems using BASIC to solve some mathematically oriented business problems. These include interest rate calculations, budgeting, financial math, depreciation calculations and taxes. The applications do not assume that the reader knows how to do financial math without a computer, but this knowledge is obviously useful if you are to apply the programs. In other words, the text teaches you how to solve the problems, but not when to solve them.

(see REVIEWS, page 20)

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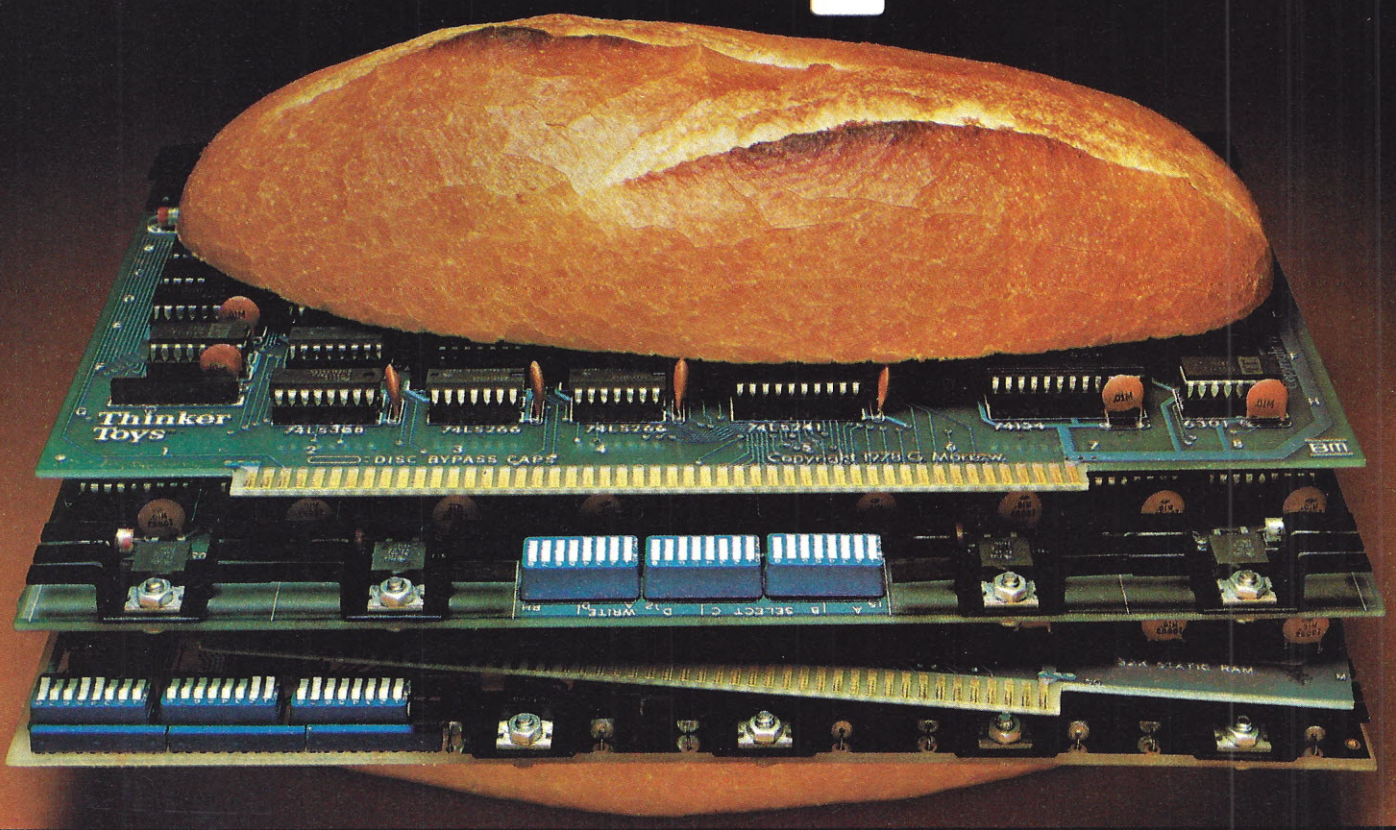
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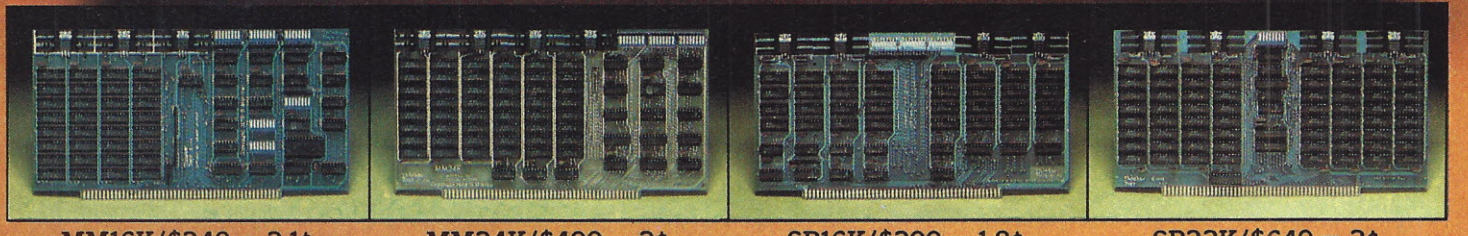
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Whichever Morrow memory suits your taste, it will run perfectly in 2 MHz 8080, 4 MHz Z-80 or 5 MHz 8085 systems. And meets the Proposed IEEE S-100 Standard.

2¢ a byte! That's food for thought. And they're ready to take out at your local computer shop. Or if not, we deliver. Write Thinker Toys,™ 5221 Central Ave., Richmond CA 94804. Or call 415-524-2101 (10-4 Pacific Time any weekday).

Morrow Designs T28

Thinker Toys™

NEW PRODUCTS

Edited by Dennis Brisson

HARDWARE

Smart CRT Terminal

The ADM-42 is a video display terminal with total flexibility of format, editing, interface and transmission from Lear Siegler, Inc., 714 N. Brookhurst St., Anaheim CA 92803. It comes standard with two 1920 character pages of memory that can be optionally expanded in two-page increments to eight full pages, which have independent Protect, Write/protect, Program mode and Cursor retention characteristics that are automatically retained in the terminal's memory for recall when the user pages to another screen of data.

The ADM-42 features a detachable keyboard with uppercase and lowercase, numerics, punctuation, control, numeric keypad and 16 function keys, which are shiftable to initiate 32 specific functions external to the terminal and blinking, blanking and reverse video visual attributes. Programmable function keys are also available. The terminal features a high-resolution, 15 inch diagonal display screen with characters arranged in 24 rows of 80 characters and a 7×9 dot matrix. A 25th line is also provided exclusively for terminal status indicators and messages up to 79 characters. Price is $1795. Reader Service number S127.



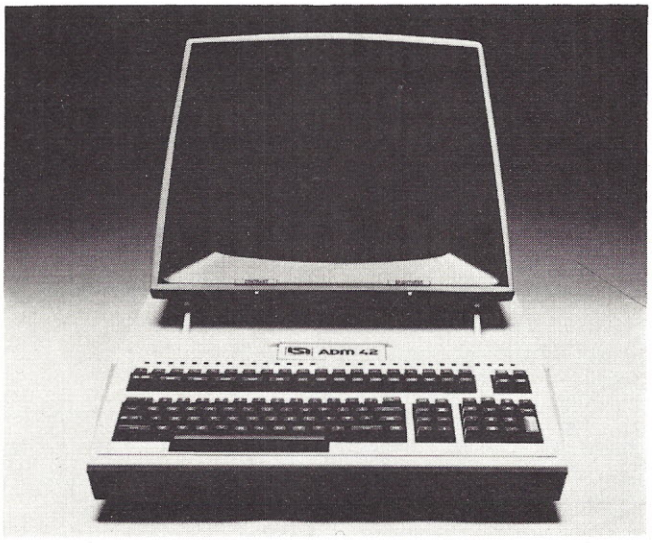
Interface for the Axiom printer.

Axiom Printer Interface

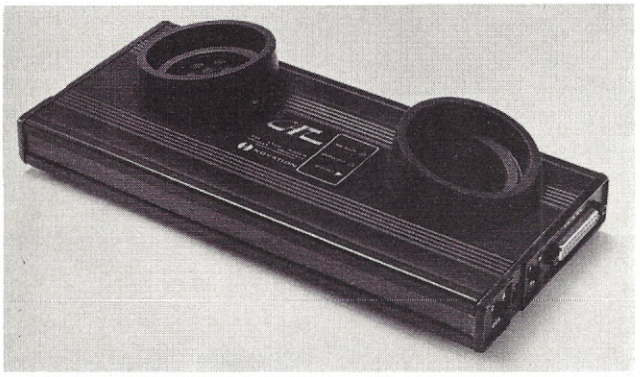
Now you can plug the Axiom printer right into your TRS-80, Apple II or PET microcomputer and start printing with no modification to hardware or software. The built-in interfaces for Axiom's EX-800 series of microprinters and microplotters come with cable and connector.

Model EX-801 microprinter has uppercase and lowercase alphanumeric characters plus the graphic symbols used by the TRS-80, Apple II and PET. The EX-820 microplotter provides precise alignment for both horizontal and vertical dot patterns for a true hard copy of computer-generated graphics. The compact printer operates at up to 160 characters per second and offers users the choice of three character sizes to provide 80, 40 or 20 columns. The EX-801 with interface is $535, while the EX-820 is $895.

Axiom Corporation, 5932 San Fernando Road, Glendale CA 91202. Reader Service number A110.



The ADM-42.



The CAT.

Electric Crayon

The Electric Crayon is a control microcomputer with an integral video display generator. The self-contained system includes RAM, ROM, a microprocessor, the video display generator (VDG) and other components required for stand-alone control applications, but it may also be used with any computer with a parallel 8-bit I/O port.

The Electric Crayon communicates—with handshaking—to other devices through any one of its four bidirectional 8-bit ports. The VDG circuit allows generation of both alphanumeric and graphic displays for "painting" animation characters, graphs, charts, messages and other displays on a color TV monitor.

The Electric Crayon includes Percom's ROM-based graphics operating system, EGOS, which communicates with the TRS-80 Level II BASIC language and may be easily adapted for other BASIC dialects. Price is $184.95 for the Electric Crayon, together with the EGOS operating system, 1K RAM for 64×64 or 64×128 color graphics and the instruction manual.

Percom Data Company, 211 N. Kirby, Garland TX 75042. Reader Service number P87.

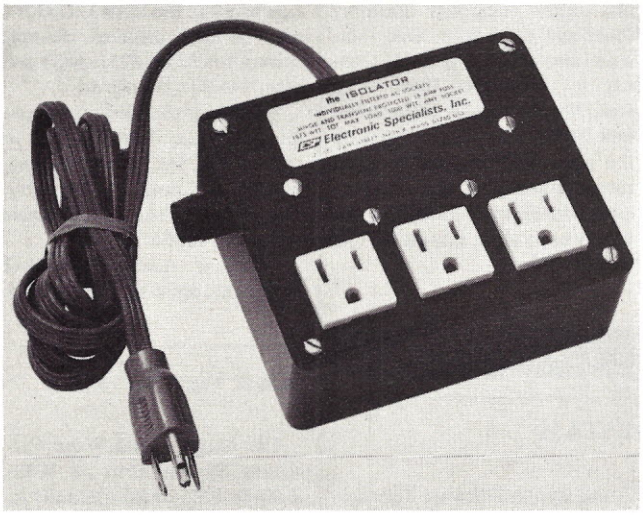
Acoustic Modem

The CAT, an acoustic modem weighing 1.5 lbs., has been introduced by Novation, Inc., 18664 Oxnard St., Tarzana CA 91356. This 300 baud answer/originate EIA RS-232C modem is engineered to transmit data over all telephone lines, is Bell 103 compatible and has an ac wall-mount transformer.

The contemporary, low-profile (2.3 inches) case features switches for mode selection and operation, as well as LEDs for displaying unit status. Acoustic self-test is standard. The compact power-pack plugs directly into wall sockets, reducing heat and voltage hazards in the unit. There are no dangerous voltages inside the CAT. Price is $199. Reader Service number N30.

Surge and Transient Protection

The Isolator is composed of three individually filtered three-prong ac sockets with integral surge suppression. With each socket isolated from the other sockets, equipment interactions are eliminated, yielding error-free and glitch-free operation.



The Isolator.

The Isolator is particularly valuable for isolating the microprocessor from peripherals as well as isolating disruptive line hash and damaging power line surges.

Connecting to the 120 V ac line with a standard three-prong plug, the Isolator can accommodate an 1875 Watt total load, with each socket capable of handling a 1000 Watt load. Price is $54.95.

Electronic Specialists, Inc., 171 South Main St., Natick MA 01760. Reader Service number E36.

32K for 6800/6809

Gimix, Inc., 1337 West 37th Place, Chicago IL 60609, announces a fully static 32K RAM board for the SS50 (6800) and SS50C (6809) bus. The board features four independently DIP-switch addressable 8K blocks. Each block can be addressed to any 8K boundary or disabled. The board is capable of decoding the four additional address lines of the SS50C bus to allow memory decoding up to 1 megabyte. DIP switches enable or disable the extended addressing and set it to one of 16 possible banks.

Designed for high noise immunity, the board uses low-power 2114L RAM chips and typically draws 2 Amps for 32K. It comes fully socketed and has gold bus connectors. Prices are $548.15 (32K), $328.12 (16K) and $438.14 (24K). Reader Service number G28.

High-Speed Serial Printer

The Model DS180 is a dot matrix serial printer that prints at 180 cps using bidirectional, logic-seeking control of the carriage. Under microprocessor control, the printhead automatically performs high-speed tabs over blank space in the text and takes the optimum path to the next printable character. Throughput is 500 lpm at 10 characters per line and 75 lpm at 132 characters per line.

The DS180 uses a 9×7 matrix to generate the 96-character ASCII set with true descenders. It prints 132 column lines at 10 cpi with selectable, expanded characters at 5 cpi. Standard features include top of form, horizontal and vertical tabs, perforation skip-over and auto line feed. Standard interfaces include RS-232C, current loop and Centronics-compatible parallel.

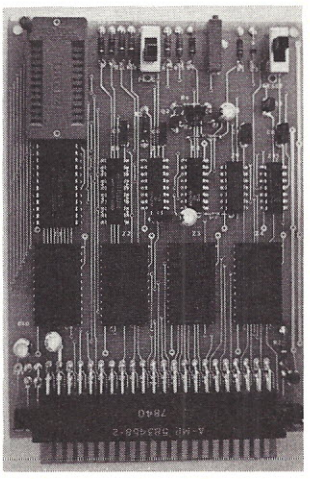
All printer parameters are programmable from an integral keypad or via the data stream. A special nonvolatile memory retains these settings even when power is switched off. A terminal status panel with a programmable LED display is used for setting the format and performing diagnostic routines. Price is $1295.

Datasouth Computer Corp., 627-F Minuet Lane, Charlotte NC 28210. Reader Service number D65.

EPROM Programmer for the AIM-65

The Model 6516 Programmer, a simple-to-use 2716 EPROM programmer for the Rockwell AIM-65 computer, provides all hardware necessary to program 5 volt 2716s, including a zero insertion force programming socket. Additional sockets allow execution of 8K bytes of user programmed EPROM. Easy interface to the AIM-65 is provided by both a 44-conductor female connector, which allows direct connection to the AIM-65 expansion connector, and a 44-conductor male edge connector, which allows the programmer to plug into expansion motherboards.

An interactive monitor ROM contains all routines necessary to not only program EPROMs, but also provide many other useful functions. Monitor commands include program, compare, transfer, erase, fill, move and load. Price is $149.



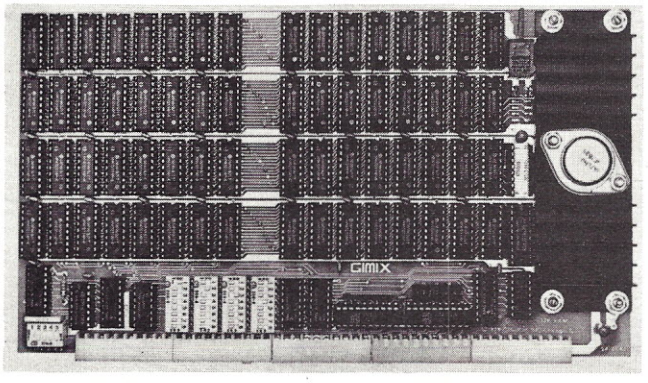
6516 Programmer.

Cubit, 897 Independence Ave., Building 4A, Mountain View CA 94043. Reader Service number C178.

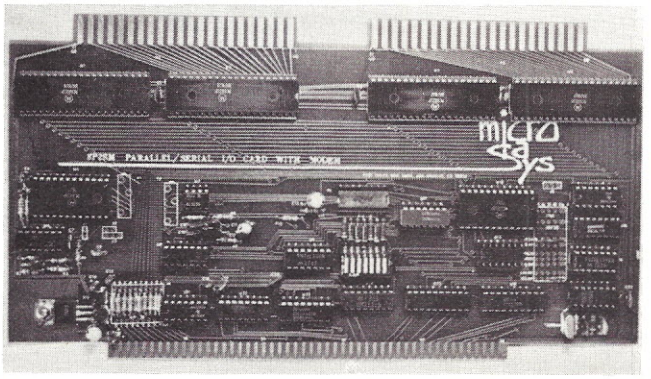
Parallel/Serial I/O Card with Modem

The Model 8P2SM-C Parallel/Serial I/O (input/output) card with modem provides eight parallel bidirectional data ports (64 I/O bits) with full handshaking and interrupt handling (another 16 I/O bits). In addition, there are two serial input and output ports. The user can configure one set of serial ports for full RS-232 operation, and the other as a full duplex answer or originate modem or byte standard cassette interface.

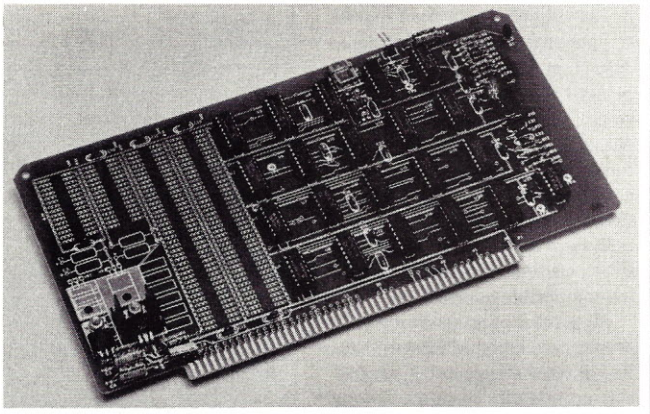
The board can be set up for either memory-mapped or port-mapped I/O and will work in any Z-80, 8080, 6800, 6802, 6809, 6502 or 8085 system with the



Gimix's 32K RAM board.



The 8P2SM.



Fast-scan video digitizer.

S-100 bus. A complete documentation package is included with the board. Price is $149, kit, and $199, assembled.

MicroDaSys, PO Box 36051, Los Angeles CA 90036. Reader Service number M110.

Video Digitizer

A fast-scan video digitizer that operates on data from a video camera is available from Vector Graphic, Inc., 31364 Via Colinas, Westlake Village CA 91361. The new device, for S-100 bus computers, converts output from the camera—or other source of composite—into 8-bit gray-scale digital information.

Data can be transferred via software to either a memory-mapped high-resolution video board or to main memory for subsequent retrieval. A complete driver program, implementing 16 shades of gray, is included for controlling the board, displaying images on a high-resolution video board, storing images on disk and printing images on a matrix printer. Maximum horizontal resolution is approximately 700 points per line. Vertical resolution offers 480 lines per image (normal). Price is $175. Reader Service number V10.

PUBLICATIONS

TRS-80 Catalog

"The Expanding World of TRS-80," Radio Shack's TRS-80 Microcomputer Catalog RSC-3, includes complete, up-to-date information on both Model I and Model II TRS-80 microcomputer systems. The free, 24-page, full-color catalog lists such peripherals and accessories as five-line printers, disk expansion units, a voice synthesizer, system desk, dust covers, carrying cases and software, including more than 50 ready-to-run programs.

Detailed specifications shown in the new catalog include a TRS-80 system selection guide, comparison charts for Level I and Level II BASIC, a description of Disk BASIC and TRSDOS operating systems for Model II.

Radio Shack, 1300 One Tandy Center, Fort Worth TX 76102.

Tool Catalog

Catalog 62H-1979 is the largest catalog of wire-wrapping tools and other electronic assembly tools and parts from O.K. Machine and Tool Corp., 3455 Conner St., Bronx NY 10475. This free, 20-page catalog features the new PRB-1 10 ns Logic Probe on the cover and contains a broad range of products and specifications of interest to industrial and hobby users alike. Reader Service number O5.

SOFTWARE

BSTAM

The Byrom Software Telecommunications Access Method (BSTAM) enables transmission of program or data files between any two computers on which BSTAM is installed and is compatible with all 8080/Z-80 systems using CP/M operating systems or a derivative. Transmissions are made over a normal voice grade telephone line at 300 baud and over direct wire interconnections at 9600 baud.

BSTAM has the capability to precisely transfer data over poor circuits, with automatic retry provisions and perfect reporting in the event of "hard" errors. The user interface provides for wild-card expansion of file names, permitting a sequence of files up to a whole diskette to be sent—the sending module automatically announcing the file names to the receiving computer. Interfaces to the UART/USART may be user installed. Sample drivers for 8250, 8251, 6850 and other UARTs are provided.

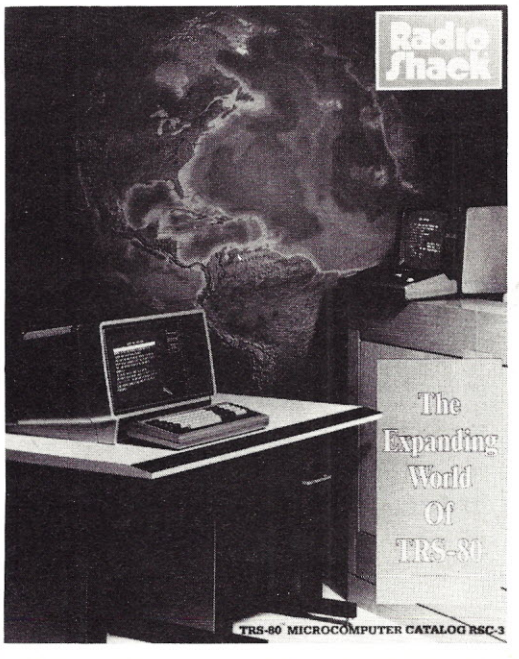
BSTAM is supplied on diskette in all popular formats. The license fee of $150 covers installation on the single system only. The documentation is available separately for $5.

Lifeboat Associates, 2248 Broadway, New York NY 10024.

Magic Wand

The Magic Wand Word Processing System turns an 8080-, Z-80- or 8085-based computer into a versatile word processor. The system, which utilizes the CP/M operating system, consists of a text editor and print processor. The editor runs on any serial or DMA terminal and includes full-screen cursor manipulation, global search and replace, block manipulation, library (merge) files and spool (background) printing. The print processor works on both standard and specialty printers and includes flexible pagination and margination, automatic headings and footings, underscoring, boldfacing, sub/superscripting and variable pitch control.

The Magic Wand offers variables and external data files (for easy form letter generation), conditional commands and true proportional printing utilizing a proportional print wheel on a spe-



Catalog RSC-3.



Catalog 62H-1979.

cialty printer. The user's manual contains a 78-page step-by-step instructional program in which the user interacts in a controlled environment with sample files contained on the system disk.

Small Business Applications, Inc., 3220 Louisiana, Suite 205, Houston TX 77006. Reader Service number S92.

Business Mail System

Designed for large-scale business users with a TRS-80, at least 32K of memory, a printer and two disk drives, the Business Mail System will allow the user to store up to 150,000 names on a single, large file composed of multiple diskettes. The software sorts the entries into zip-code order and alphabetical order within the zip code. As new entries are made, the file is expanded automatically by the computer. In other words, the file will grow from one diskette to two, all the way up to 300 diskettes, each of which holds 500 names.

The Business Mail System allows the user to use one through four labels at his discretion. It provides for the printing of either three or four line addresses. It further allows the user to program which names he wishes to print out by the use of up to ten exclusive and non-exclusive codes. Price is $125.

The Bottom Shelf, Inc., PO Box 49104, Atlanta GA 30359. Reader Service number B44.

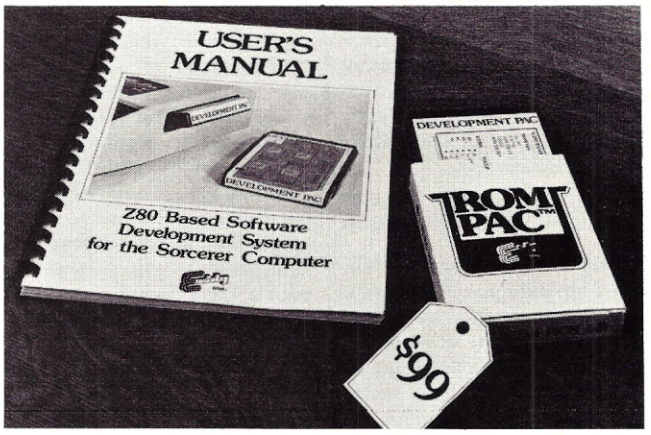
Development PAC for the Sorcerer

The Development PAC is a plug-in ROM PAC cartridge that can turn an Exidy Sorcerer into a relatively advanced, cassette-based Z-80 development system for hobbyists and home users.

The Development PAC includes four modules: a Designer's Debugging Tool (DDT), a line-oriented text editor, a relocating assembler and a linking loader. All can operate with the Sorcerer's dual cassette interface to allow tape-based system development. The system allows programs of virtually unlimited length to be developed in modules. The system supports global (external) symbols for inter-module communication and allows the user to define the I/O devices for source, object or listings.

The user can choose to upgrade to an Exidy disk system and maintain compatibility with all of his source, object and machine-executable tape files. Since the Exidy computer is CP/M compatible, this conversion is handled via the CP/M operating system by means of a software package that converts tape files to disk with relative ease. Price is $99.

Exidy, Inc., 969 West Maude Ave., Sunnyvale CA 94086. Reader Service number E44.



Exidy's software package.

LETTERS TO THE EDITOR

9368 Sources

In the December 1978 issue you published my article on how to construct an address display for the COSMAC Elf II. I've received letters asking the same question: "Where can I get 9368 binary to 7-segment decoder/drivers?" Since this seems to be a universal problem, I thought I should try to answer that question through your magazine.

I originally decided to use 9368s because the Elf uses them. But I had a terrible time finding them. The 9368s decode all binary states to produce the hexadecimal code 1-9 and A-F, unlike all popular BCD decoders available from Radio Shack or other such places. I could also find no other replacement. I then remembered that my Heathkit Digital Design Experimenter (Cat. #EE-3201) used a 9368 in the Digital Techniques course, and I ordered four of them as a replacement part (Part #443-694, UA9368) at my local Heath store. I did encounter some resistance to ordering four, since the kit uses only one. However, two weeks later, and at $4.50/driver, I was the proud owner of four rare 9368s.

At work I needed to develop a latched data-output display for four parts and needed to obtain eight more of these scarce ICs, so I looked for a new source. They are also sold by Hamilton-Avnet Electronics, 7235 Standard Drive, Hanover MD 21076, (301) 796-5000. This chain exists in most every state, but sometimes goes under the names of Hamilton Electro Sales, or Avnet Electronics or some other variation.

It is hard to believe there are so few sources for drivers that decode a full 4-bit binary for hexadecimal display, but that seems to be the situation.

Robert J. Cotter
Baltimore MD

Expanded Expansion

I want to point out three items as a supplement to Mr. Domuret's excellent article, "Expanded TRS-80 Disk Operations," October 1979, p. 78.

1. For those programs like Sargon II that expect a Level II, non-disk system, you need to change the RST instructions. This should be done before the move instructions. The code to insert is:

```
3E C9      LD A,C9
32 0C 40   LD (400C),A
32 0F 40   LD (400F),A
32 12 40   LD (4012),A
```

2. The start address for Sargon II is 5000 hex.

3. For most programs it is not necessary to have a monitor. Simply use BASIC2 to PEEK and POKE as necessary. Very short programs will usually fit. You can fill memory, display, move and change all with short programs keyed in as necessary.

I hope this is of help to your readers.

Albert J. Marino
Chatsworth CA

"Sample" Supplement

The article " 'Sample' the 6100" in the December 1979 issue of *Microcomputing* was a gem. As the virtual inventor of the minicomputer, Digital Equipment Corporation has a great deal to offer the hobbyist, yet precious little about DEC sees light of day in the hobbyist press.

As a longtime fan and admirer of Digital Equipment Corporation, I'd like to volunteer a little additional information.

DEC makes a whole series of minicomputers with the general designation "PDP-8." The Intersil 6100 "sampler" described in the article most closely resembles the PDP-8E system . . . an important consideration in seeking software.

One of the great beauties of the PDP-8 is the ocean of software available for it at little or no charge: from government agencies, educational institutions, various nonprofit organizations and the military. This is in stark contrast to the hobbyist/microcomputing industry where software of poor quality and dubious value is offered with $100 price tags, and there is constant petty squabbling over ownership, re-

sale, copyrights, etc.

The Intersil 6100 is the granddaddy of microprocessors intended to emulate large-scale computers. There is now (or shortly about to be) a chip set that imitates the IBM System 370.

A. C. Acton
Midland MI

Forgive me for being a skeptic, but I've heard about the oceans of software for years now, and I still can't find any at no or low cost. Also, I haven't seen any articles with specifics about getting all this wonderful software. If it really is there, how about some articles on getting it?—Wayne.

You Are What You Eat

After reading John Cameron's "Adult Caloric Requirements" in the September 1979 issue, I decided to see if my Apple II would run it. I typed it in, and after a couple of syntax errors, the program ran well.

I was going to work, and I asked my 5' 9", 123-pound wife to run the program. Suddenly I heard her yell, "EEK!—there is *no* way I'll weigh that much!" My Apple returned: "Your weight should be 147 pounds." I assured her that I was perfectly happy with her the way she was.

I grabbed the magazine and went to work. Ironically, while at work, I ran across a doctor at the local hospital, and I asked him about the basal metabolic rate. He stated that BMR was used to calculate the caloric requirements based on oxygen and intake in order to detect thyroid disorders. Further, he stated that the system was not accurate and was useless.

All was not lost, though. I liked the style of the program. The program ran in the Apple II (only had to delete line #460). I am adding a line: Line #125 If WT = 123 AND HT = 69 THEN PRINT "You are just perfect the way you are—APPLE II.": END.

Joe Carron
Stow OH

First, I react to any suggestion that my efforts have been useless. I obviously disagree since I use the program myself as do many people who plan diets using the charts of ideal weights and caloric intake present in virtually every book on the subject. You are quite correct that the calculations of BMR, caloric intake and ideal weight are imprecise. The ranges typically given are −15 percent to +5 percent for BMR (basal metabolic rate is required for caloric intake calculation) and about +/−10 percent for weight (given in the program). Not surprisingly, people are often exceptional (I have yet to see a truly average person). Your wife is one of those whose weight happily falls below what is considered the normal range for even a slight-framed 69-inch female (three pounds less, in fact, on the typical table). Nevertheless, this does not eliminate the general usefulness of these estimates along with the person's own goal as a starting point for dieting. Virtually all of the laboratory data used in medical diagnosis has similar imprecision.

The statement that the BMR is useless is peculiar. I suspect it denotes this doctor's (and many others') lack of concern about nutrition. In order to plan a diet, one has to start at some estimate of caloric intake and alter it with experience. This estimate is obtained using tables, which my program contains in computer form. One can (and many do) just eat 1000 calories per day, but this is not likely to work over many years. I believe it is necessary to help people plan a diet they can live with every day. I refer you to any book on the theory of nutritional planning (e.g., Recommended Dietary Allowances) to demonstrate that the BMR is used today more often in relative health than in sickness. As a medical student, I heard several lectures on thyroid disease but none on how to plan a patient's diet.

Dr. John R. Cameron
Palo Alto CA

Digs Disks

I thought the evaluations of mini-floppy disk systems in Pete Stark's SWTP series were very good. If they'd been published a few months earlier, they would have saved me agonizing over which disk system to get (I finally got an MF-68 because a local user was upgrading to 8 inch floppies). You had the kind of information that doesn't appear in the manufacturer's brochures.

Can you do the same for the 6809 systems and boards that are beginning to appear?

William R. Hamblen
Nashville TN

See the January 1980 issue.—Editors.

"Twin Cassettes" Mod

This letter contains a modification to the piece of equipment described in "Twin Cassettes for Your TRS-80" by Les Logan, April 1979, p. 84.

The equipment described in the article will not work with the assembled output of the TRS-80 editor/assembler because the assembler output contains pauses of up to about ½ second during which the assembler is occupied with other things. The cassette drive is not turned off, however. Thus the dual cassette interface reverts to a "read" condition and switches to the "read" recorder. To avoid this, increase the "write" monostable multivibrator time constant by increasing C3 by a factor of 100.

C. Nielsen
Trenton NJ

Software Observations

Publisher's Remarks on p. 6 of the October 1979 issue has prompted me to write. Wayne said, "Can you sell TRS programs to Radio Shack stores?" and then went on a binge condemning people who couldn't. Ms. Smythe had a different answer to your question in Output from ISI on page 8: "Radio Shack stores are prohibited from selling programs other than those released from Ft. Worth." Who is correct?

I believe that Ms. Smythe is correct. Radio Shack can market anything they please in any way they want. If this is bad for the sales of computers and software, so be it! This is also hurting ISI's sales, isn't it?

You really want Radio Shack to give you a free ride by their selling tons of ISI software. It's good stuff and would make everyone happy, but Radio Shack couldn't care less about doing so. What you need to do is make a big hit with your software in spite of the biggest computer manufacturer in the world!

A lot of businesses are failing today due to poor management and the disastrous manner in which our country is being run into the ground. It is hard enough just staying in business without trying to start new companies in relatively new fields.

Your comments about earning big money (which I am all for) and starting new computer-related businesses are mostly a lot of hot air that doesn't help the people trying to do these things. I would like to quit my current job and start working in a microcomputer-related field. Your tirades have not helped me at all. I want to learn the trade, not start a business that will fail.

I am interested in software. In my opinion, *Microcomputing* has published more useful software in the past. I couldn't care less about the trendy hardware articles you have been publishing on the TRS-80, PET and APPLE. I don't own one of these or have use of one at this time, though I would like to learn the software used on them. I hope the TRS-80 articles will "disappear" with your new magazine soaking them up! I have a North Star Horizon and am looking for more programs to use on it. I am quite happy to convert useful BASIC programs into North Star BASIC.

Saul G. Levy
Tucson AZ

Tandy stockholders are looking for profits to share, and the management is aware of this. If Radio Shack can make more money by selling other manufacturers' products (including software), I think you'll see them going this practical route. I have seen no sign that Radio Shack makes any poor business decisions, despite some cherished policies of the past. Free ride on software? The ISI staff, knowing how much work and investment has been put into the venture, got a big laugh out of that one. As for going into business, you apparently have not been reading many of my editorials . . . and have drawn conclusions from far too little data. I went into detail on how to learn the business and avoid the normal pitfalls.—Wayne.

Application Note

When a new *Microcomputing* arrives, the first section I read is Letters to the Editor. In the November 1979 issue, I noted a letter from Royal Scott on interfacing the TRS-80 to a Heath H14 printer. As an owner of an H14 and a member of the New River Computer Club, most of whom own TRS-80s, I should point out that Heath has had available since June 15 an application note dealing with such an interface. This

clearly readable printouts clearly remarkable price

The $625* Heathkit H14 Printer. You'll pay hundreds more for a printer with its features.

Where else can you buy a microprocessor-based printer with the H14's features and copy quality for under a thousand dollars?

The Heathkit H14 prints up to 165 characters per second, one full line every two seconds.

5 x 7 dot matrix and finest quality impact printhead give you clear, easy-to-read images.

All functions are microprocessor-controlled for reliable performance and more efficient use of your computer.

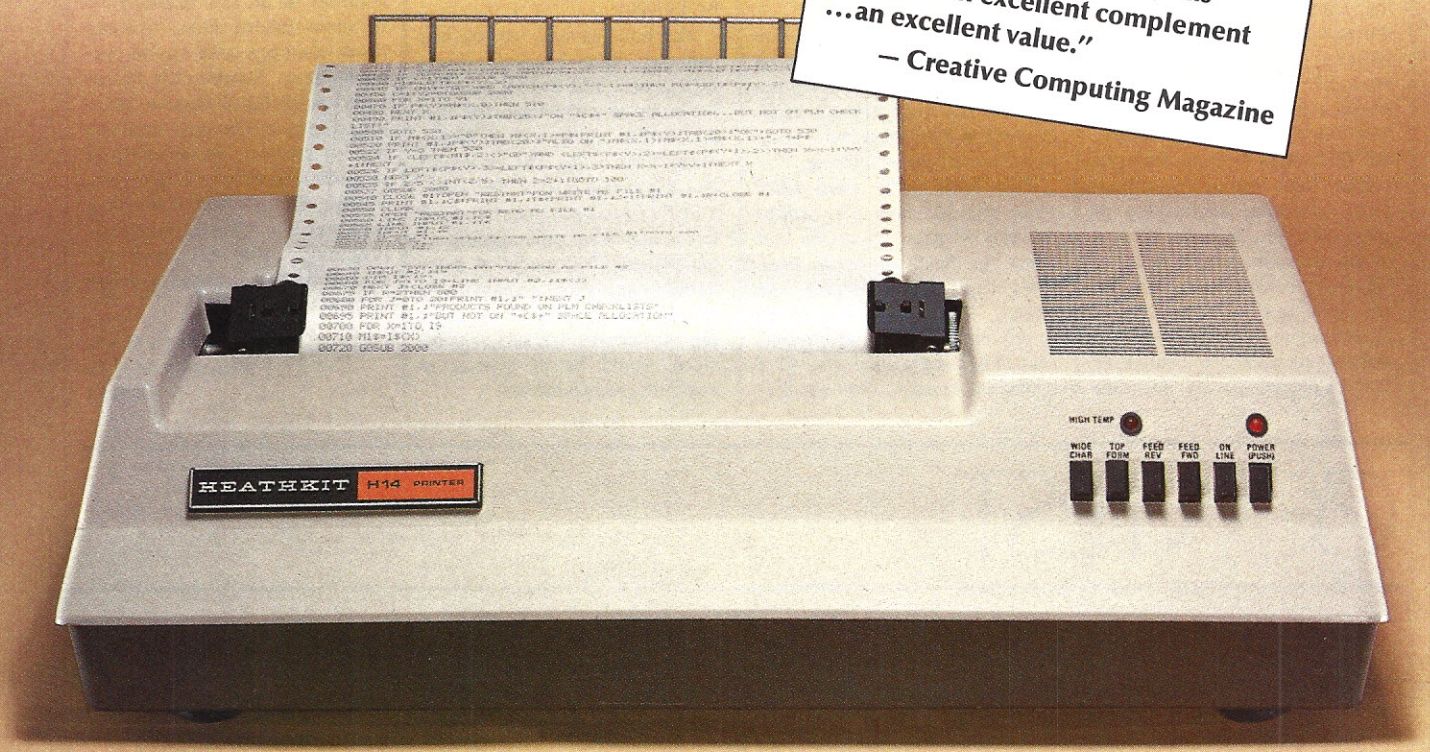
You get:

- Standard 96-character ASCII set—UPPER and lower case.
- Operator or software selectable line width: 132, 96 and 80 characters per line.
- Compatibility with any computer having RS-232C or 20 MA current loop serial interface with handshaking.
- Sprocket paper feed, with adjustable spacing, keeps paper moving smoothly.
- "Paper out" and "paper jammed" signals prevent loss of data.
- Selectable baud rates from 110 to 4800.
- Convenience of standard fan-fold paper, 2.5 to 9.5 inches wide.
- Chrome wire rack keeps paper neat.

Price includes connecting cables, paper rack and ribbon. Just add paper and you're ready to run. And service on the H14 is close by at any of 55 Heathkit Electronic Centers throughout the U.S.

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Heath Company, Dept. 343-634, Benton Harbor, MI 49022

CP-180

bound, six-page booklet details exactly how to wire the two together, pin-by-pin, and provides a driver routine in both BASIC and Z-80/8080 assembly language for the TRS-80. I'm told that the driver is superior, on several counts, to the one supplied with the TRS-80 expansion interface. At any rate, a note to Heath should get the TRS-80 owner a copy.

D. C. Shoemaker
Blacksburg VA

Initiative

I hope I have been able to advance the sales of *Microcomputing* and Instant Software into a new source. A new computer store, Miss Micro, which opened in Jackson, sells PET and Cromemco systems.

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I returned the next day with a supply of back issues and pointed out to the owner that he should stock *Microcomputing*. Then I mentioned Instant Software and showed him ads to illustrate ISI's inventory. I also told him that *Microcomputing* had purchased an article from me.

I hope that other readers make the commitment to make *Microcomputing* the most rapidly growing magazine in the field.

Gary Ratliff
Mendenhall MS

Gary, you get a gold star for your consideration. But, you are right. The more readers we get, the more advertising we will get; that brings a lot more articles, so everyone gains. We do try to help new computer stores make money and educate customers with our magazines and books, but every now and then someone opens a store and doesn't let us know. Keep your eyes peeled, readers, and pass the word.—Wayne.

REVIEWS

(from page 9)

The one potential trouble area in this book for the computerist is the use of files. Those who are running Microsoft's Extended Disk BASIC or an equivalent can apply this section; the rest of us have to either just drool over it or trick our BASICs into using files.

As an introduction to BASIC this text is OK but not outstanding. The reason for reviewing it is not to damn it with faint praise, however; I consider it a useful book. The second part of the text is what stands out. This is ideal for someone who is just learning BASIC and wants business examples rather than the conventional math, statistics, engineering or game examples. Also, for the cost of the textbook you get many of the business-related programs that are found in the more expensive collections of BASIC programs, and you get good explanations of how the programs work. So, while this is not a text for everyone, it is a good text for those who want to learn business programming, and especially those who would like to have some useful business software as an offshoot of their learning experience.

John A. Lehman
Ann Arbor MI

57 Practical Programs & Games in BASIC

Ken Tracton
Radio Shack (Cat. No. 62-2008)

Frustration is spending one hour with pencil, paper and hand calculator solving a one-time-only job that your microcomputer could handle in minutes after two hours of programming.

This book gives some relief from this dilemma. The author presents 57 short programs that cover the fields of math, business, electronics, statistics and games. These include logarithms to any base, compound interest, resistance calculations, five statistical means, yet another space-wars game and a bubble-sort routine. I am sure that anyone reading this magazine could have written any of the programs, but they are presented like convenience foods—just pop one into your machine and RUN.

Tracton describes the BASIC used as a "standard" one. Would that there were such a thing! In fact, it is Radio Shack's version of Microsoft BASIC . . . surprised? However, as strings are used only in the day-of-the-week program, you can very easily translate each program into your own dialect.

The book is well written and laid out. Each program begins with a title and description followed by any mathematical formulae used. A typical RUN follows. Then come the flowchart and the actual BASIC program. This format allows you to modify any program for your specific requirements. One exception is the bubble sort, which gives nothing but the listing. This is sad since the way in which a sort is organized would be of interest to beginning programmers.

The main failing of this book is the poor grouping of the programs in the index. They are simply arranged alphabetically with no attempt to sort them by field or function. A second disappointment is the lack of any graphics. Don't mistake the program called "Curve Tables (plotting)" for some. Finally, the games are rather elementary. I suspect they were picked mainly by name and chosen to give the book more pizzazz and a more salable title.

This book would be a useful addition to all our bookshelves for three reasons. First, there are times when you need a good program—now. Second, the layout makes it useful to anyone learning to program because it allows you to see how an experienced programmer attacks a problem. Finally, the subroutines will find their way into many of our longer programs. However, remember that all programs in the book are copyrighted.

Bruce Evans
Pickering Ontario
Canada

CONTEST

Please disregard the "Best Article of the Year" contest ballot in the December 1979 issue. Due to a computer error, the winner for December 1978 was listed as Ed Juge, author of "The TRS-80: how does it stack up?" The winner should have been Barry A. Lewis, author of "Deep, Dark Secrets of the TRS-80 (Level I)." All the winners are shown below. Please cast your vote on the Reader Service card at the back of the magazine. Sorry for the inconvenience.

Not yet eligible for "best of the year," the winner for November 1979 is Dr. Joseph Sanger, author of "Electronic Librarian."

1. "Let Your Computer Wear a Watch," Brooks, Oct 1978.
2. "Hey, Kids! It's 'Mickey Modem!'" Gibson, Nov 1978.
3. "Deep, Dark Secrets of the TRS-80 (Level I)," Lewis, Dec 1978.
4. "TRS-80 Tape Controller," Rowlett, Jan 1979.
5. "It's There—But Where?" Mathis, Feb 1979.
6. "PET User Port Cookbook," Yob, Mar 1979.
7. "A Look at TRS-80 Peripherals," Cowan, Apr 1979.
8. "A Text Formatter in BASIC," Law, Mitchell, May 1979.
9. "'Monitor,'" Hallen, Jun 1979.
10. "IC Logic Tester," Ruckdeschel, Jul 1979.
11. "Machine Language Monitors for TRS-80," Edmonds, Aug 1979.
12. "The Failure of a Micro in Business," Kepner, Sep 1979.

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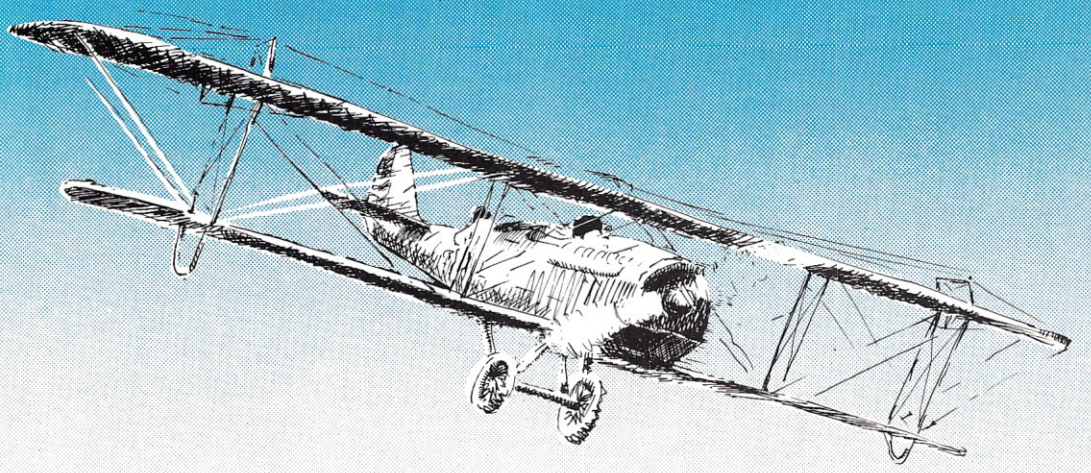
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✓ Reader Service index—page 241

NAVPROG:



Flying from here to there is more fun when your H8 does the hard part.

Leland D. Young
12603 Forest Hills Dr.
Tampa FL 33612

What is the air distance from Atlanta to Disney World? I'll admit this may not be a pressing question with you, but if you were the pilot of a small airplane flying between these two locations, you would want to know this information and much more, the sum of which would amount to what may be called a flight plan.

This article explains a program I call NAVPROG, which is intended to be used as an aid in deriving such a flight plan. The program is written in Heathkit's Disk Extended Benton Harbor BASIC version #100.00.00. Even though NAVPROG deals with aviation, its basis may have applications in other areas, because the real subjects are vectors and triangulation and how they are manipulated in problem solving. In this case they are manipulated to figure distances and directions for navigation. Daniel Boone should have had it so good.

Introduction

To develop NAVPROG, a basic understanding of navigation and flying is needed. This is why I will give background information during this article as it seems appropriate. But a complete explanation is virtually impossible in the limited length of a single magazine article, so those of you desiring more information should visit the public library or an aviation bookstore.

Primarily, three models are used in the execution of NAVPROG. One model determines the distance between two locations by using spherical trigonometry; the second model determines the net result of any winds between these two locations; and the third model derives a *wind triangle*, which is used to determine the effect of wind on the aircraft's flight between these locations. From these three basic models all other aspects of the program are derived.

After some general discussion I will cover highlights of the actual program explaining their particular functions. Finally, I will conclude with some general comments on NAVPROG.

The Aeronautical Chart

Without going into detail (and believe me there can be plenty of detail), I'll just say that the charts used for air navigation have the usual features you might expect to see. Primarily, each chart shows a portion of the earth's surface and a gridwork of horizontal and vertical lines called, respectively, lines of latitude and longitude. The gridwork is used to identify locations on the portion of the earth's surface shown by the chart.

For example, if you were looking at a chart showing the west-central Florida area, you would see the St. Petersburg-Clearwater International Airport located at approximately 27° 59' N latitude and 82° 41' W longitude. In this case the W means the location is in the western hemisphere and the N means it is north of the equator. It should be noted that NAVPROG is intended to be used only in the portion of the earth just described (i.e., western hemisphere and north of the equator). Changes could be made to allow coverage for any part of the earth with no particular difficulty. However, I have not pursued this aspect.

The Distance Model

Let's now consider the distance between the two loca-

tions, Sarasota and Lakeland, Florida. Fig. 1 shows the general relationship of latitude and longitude lines. Fig. 2 shows the particular reference to the two locations. The diagonal line between the two points in Fig. 2 is part of a great circle (to be discussed later) and represents the distance between them. That the diagonal is part of a great circle is important in that it represents the shortest distance between the two points.

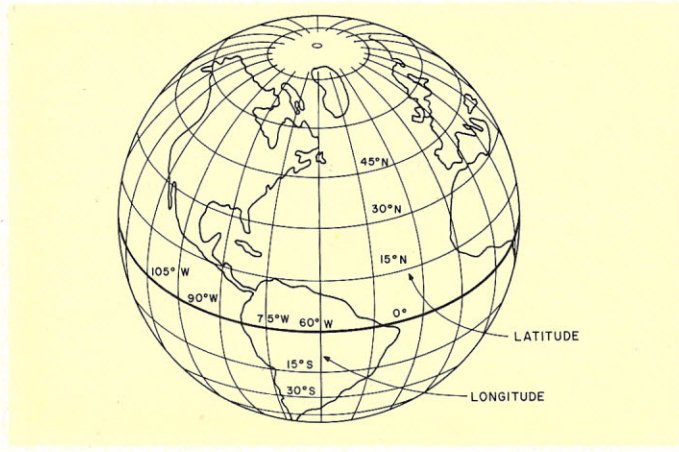


Fig. 1. Lines of latitude and longitude.

The angle S is found in order to derive the true course, which is an angle measured clockwise from the direction of true (geographic) north to the line representing the direction of travel. In this example the direction of travel is the diagonal line going from Sarasota to Lakeland.

In Fig. 2 we also see the latitude and longitude of each location represented two ways: as degrees and minutes, which is the way the information is entered by the user, and as degress only, which is the way minutes are converted by NAVPROG.

As an example, 82° 33' (read as eighty-two degrees, thirty-three minutes) is the same as 82.55° because of the relation 1° = 60'. This would be like saying 5 feet 10 inches is the same as 5.83 feet. Lines 340–360, 390–410 and 4090–4100 perform this conversion and manipulation and, using spherical trigonometry, derive the distance C(I) in line 870.

Even though the earth is not a perfect sphere, the equations for a sphere can still be used to obtain acceptable results.

The general cosine law for spherical triangles can be used to determine the side opposite an included angle if it and the adjacent sides are known. The form of the cosine law is shown in Equation 1:

$$\cos(a) = \cos(b)*\cos(c) + \sin(b)*\sin(c)*\sin(A)$$

where A is the included angle and b and c are the adjacent sides.

Note in Fig. 3 that all three sides of the triangle are parts of great circles. Allow me a brief digression: A great circle is formed at the intersection of a sphere and a plane (a plane, not an airplane), if the plane passes through the center of the sphere. All lines of longitude are great circles. The equator is also a great circle. The orientation of the plane doesn't matter, just so it passes through the center of the earth. The line between points B and C in Fig. 3 is considered part of a great circle, just as are lines b and c.

Notice in Fig. 3 that to use Equation 1 the sides b and c of the triangle must be found by subtracting the latitude of either point from 90°. This subtraction requirement is a step that can be eliminated by using the complementary functions cos(b) and cos(c) in Equation 1. By so doing, an equation can be derived where the latitude of each point can be used directly. This new equation is shown in Equation 2:

$$\cos(a) = \cos(\text{lat.B})*\cos(\text{lat.C})*\cos(A) + \cos(\text{lat.B} - \text{lat.C}) - \cos(\text{lat.B})*\cos(\text{lat.C})$$

Line 850 computes Equation 2, where P, as defined in line 840, is equal to cos(lat.B)*cos lat.C). Substituting P in Equation 2 gives us Equation 3:

$$\cos(a) = P*\cos(A) + \cos(\text{lat.B} - \text{lat.C}) - P$$

NAVPROG always maintains the absolute values for A and the term (lat.B – lat.C) in Equation 3.

The solution of the arc a (from cos(a)) in Equation 3 is given in terms of degrees because arc a subtends the central angle a, as shown in Fig. 3. Both the arc and the angle are given by the same value of degrees. The arc can then be converted to nautical miles by the conversion factor of 60 nautical miles per degree of arc. This conversion is done in the latter part of line 860.

True Course

Lines 1000–1070 find the true course from one location to another. Lines 1010–1020 find the angle S (see Figs. 2 and 4) formed at the originating point, and lines 1030–1060 determine the orientation of the triangle so as to handle the angle S properly to find the true course T(I). Keep in mind that the true course always starts at true north and is measured clockwise. Referring to Fig. 4, let's consider values of A and B1 that will place us in quadrant I. The variable A is found in line 820, and B1 is found in line 830:

A = P1(I) – P1(I + 1)
= 82.55° – 82.01°
A = 0.54°
B1 = P2(I) – P2(I + 1)
= 27.4° – 27.98°
B1 = – 0.58°

We see that A is a positive value and B1 is negative, which meets the criteria of line 1030. Notice that the fourth case in line 1060 is not actually checked but is assumed correct by default when the checks for the first three cases fail.

Magnetic Variation

Another brief digression may be in order here. A magnetic compass does not point to the earth's true north. Instead it points to a region called the magnetic north pole located to the far north of Canada. Before the aerial charts can be used

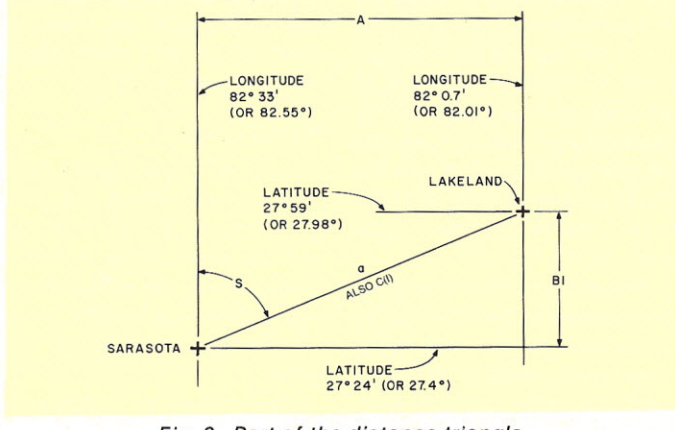


Fig. 2. Part of the distance triangle.

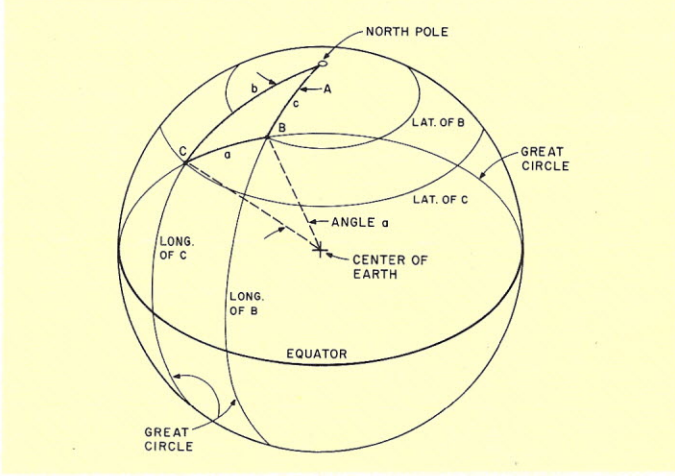


Fig. 3. Distance triangle example.

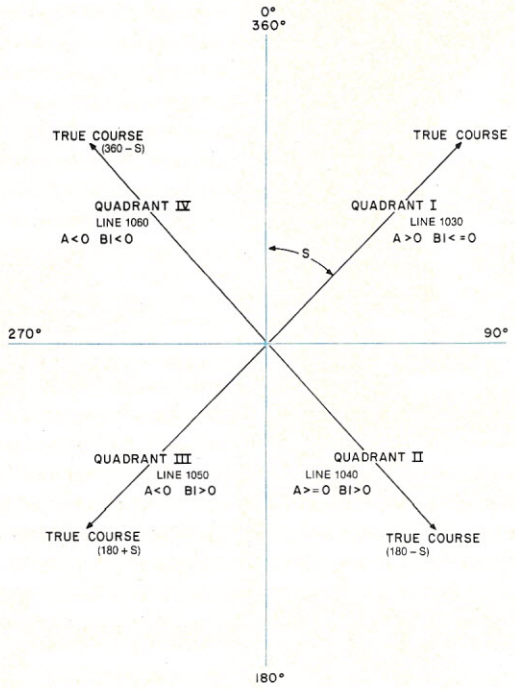


Fig. 4. Decisions model for true course.

for navigation, this discrepancy must be taken into consideration.

If you were standing at Tampa International Airport looking in the direction your compass showed as north, you would actually be looking to the right (east) of the true north pole by an angle of 1° because Tampa International has a magnetic variation of 1°E. Some areas in the U.S. have no magnetic variation, and others have variations higher than 20°.

The effect of magnetic variation can be handled fairly easily by adding to or subtracting from the true course T(I). Such a correction will yield the *magnetic course*. Note that NAVPROG handles magnetic variation initially in lines 420–500 and then applies it in lines 1300–1400.

Magnetic Course

Lines 1300–1400 determine the magnetic course by applying the magnetic variation to the true course using the rule, "east is least and west is best." This means that easterly variations are subtracted from the true course to derive the magnetic course and the westerly variations are added.

Wind Vectors

Refer to Fig. 5 and note the arrows representing the wind vectors A and B. The arrows (as vectors) point in the direction toward which the wind is blowing, and the length of the arrow represents the speed of the wind.

Weather service people give wind information at the various locations and altitudes you request. This information will be reported as the direction *from* which the wind is coming and its speed. The wind direction is given in terms of degrees referenced to true north, and the speed is given in knots (nautical miles per hour).

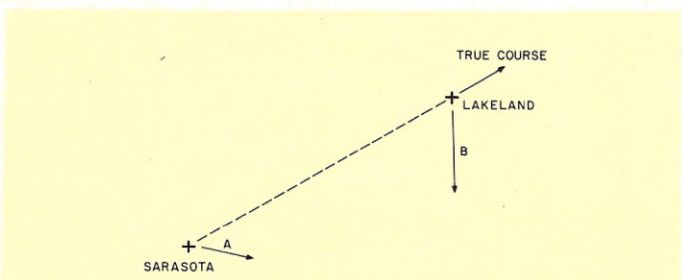


Fig. 5. Wind vectors at two locations.

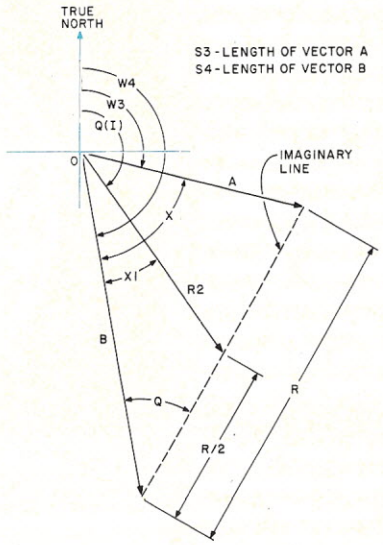


Fig. 6. Mean wind vector diagram.

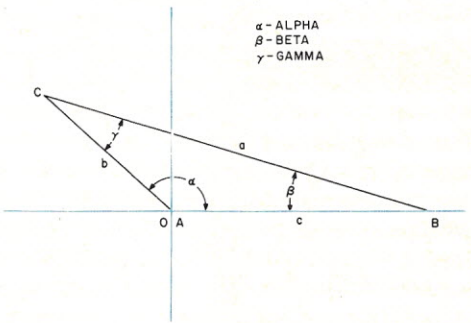


Fig. 7. General triangle.

Notice the convention used for the wind direction in Fig. 5. Although the wind direction is reported as the direction *from* which it is blowing, it is shown on the diagrams as the direction *toward* which it is blowing. The latter convention must be used so that the vector diagrams will give correct results.

Mean Wind Vector

Now we must find the *mean wind vector*. The single mean wind vector we seek should affect the aircraft going between Sarasota and Lakeland (in our example) in the same way the two separate wind vectors would collectively affect the aircraft.

The following is an explanation of the procedure used to find the mean wind vector. This vector is identified as R2 in Fig. 6. The variable X, which represents the angle formed between angles W3 and W4, is found first. This is done in line 1570. Next the imaginary line R is found by line 1610 by using the law of cosines: if two sides of a triangle and the included angle are known, the side opposite the included angle can be derived. See Fig. 7 and Equation 4, the typical equation used in plane trigonometry:

$$a^2 = b^2 + c^2 - 2*b*c*\cos(\alpha)$$

Notice that line 1610 is in the form of Equation 4. The larger triangle is next divided in half by making R2 point to the center of R. When this happens the angle X is not equally divided. I arbitrarily chose to solve for the angle shown as X1 in Fig. 6. The angle Q(I) of the mean wind vector can then be found using X1 in conjunction with W4.

Before X1 can be found, the cos of angle Q is derived. This is done by using a variation of Equation 4. By manipulating Equation 4, we can solve for the

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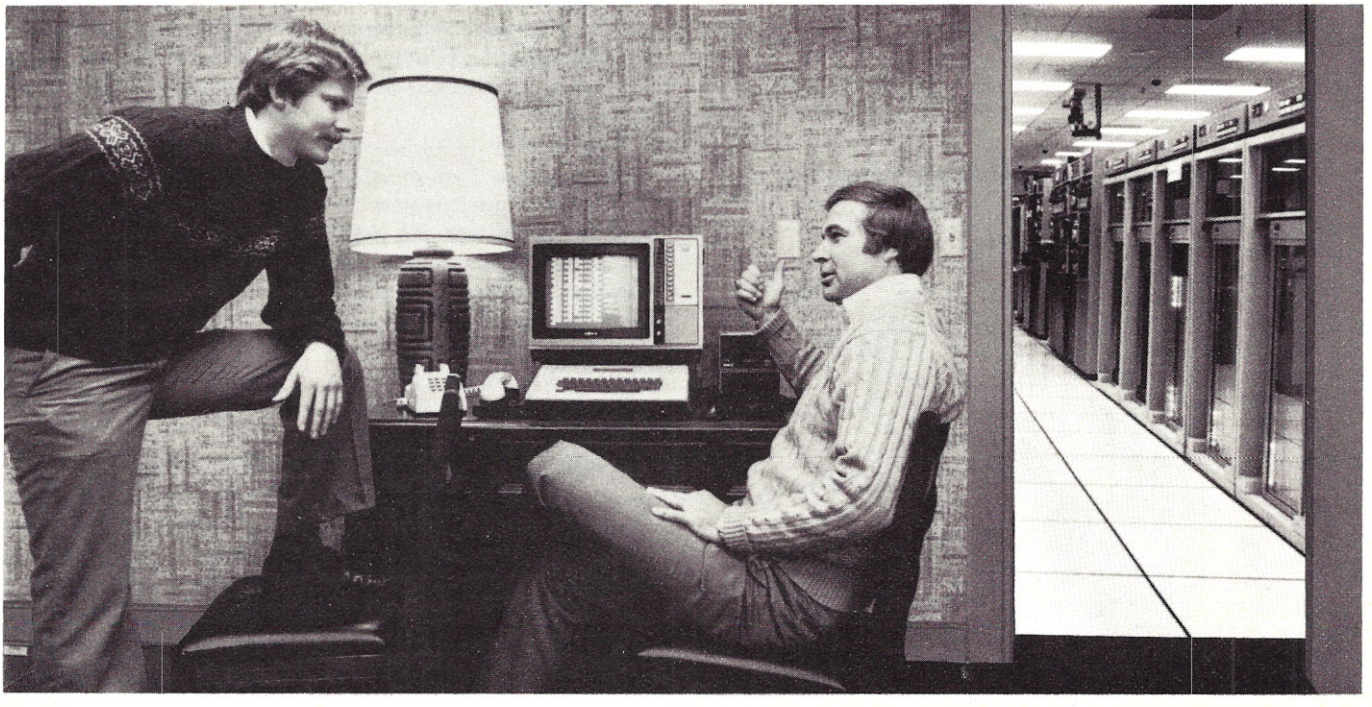
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". . . but the really impressive stuff is in the back room."

✓ Reader Service index—page 241

```
                              NAVPROG

          NOTE:  IF YOU PROMPT AN ERROR MESSAGE FROM THE BASIC
INTERPRETER, YOU USUALLY MAY PROCEED BY TYPING 'CONTINUE' AND
HITTING 'RETURN'.  THIS TYPE ERROR MESSAGE WILL BE PRECEDED BY A
BELL AND BE OF THE FOLLOWING FORMAT -

               ! ERROR - SYNTAX ERROR AT LINE  230

    THERE ARE OTHER ERROR MESSAGES GENERATED BY NAVPROG.  THESE
WILL NOT ALLOW YOU TO 'CONTINUE' FROM THE POINT OF THE ERROR.

ENTER # OF NAV. POINTS (8 MAX)3
USE STORED DATA FOR POINT # 1 ? (Y/N)
? Y
        ** USING STORED DATA **
ENTER POINT # 1  (L TO LIST)
? OCALA
USE STORED DATA FOR POINT # 2 ? (Y/N)
? N
ENTER NAME OF POINT #  2  (13 SPACES MAX)
? JACKSONVILLE
ENTER LONGITUDE OF JACKSONVILLE (DEG,MIN)
? 81,41.3
ENTER LATITUDE OF JACKSONVILLE (DEG,MIN)
? 30,29.1
IS MAG.VAR. E, W OR 0 FOR JACKSONVILLE?
? W
ENTER MAG.VAR.# NEAREST JACKSONVILLE
? 1
USE STORED DATA FOR POINT # 3 ? (Y/N)
? Y
        ** USING STORED DATA **
ENTER POINT # 3  (L TO LIST)
? ST.PETERSBURG
DIRECTION WIND IS FROM & SPEED @ OCALA (DEG,KTS)
? 40,8
DIRECTION WIND IS FROM & SPEED @ JACKSONVILLE (DEG,KTS)
? 45,8
DIRECTION WIND IS FROM & SPEED @ ST.PETERSBURG (DEG,KTS)
? 40,5
ENTER TAS (KTS) 140
ENTER FUEL RATE (GAL/HR) 10
ENTER TAKE-OFF GMT (XXXX) 1230
                                DIST    MC      MH      GS      ETE      ETA  FUEL
          LOCATIONS             (NM)    (DEG)   (DEG)   (KTS)  (H : M)  (:XX) (GAL)
OCALA         -> JACKSONVILLE  83.6    20      21.3    132.6  0  37.8  7.8   6.3
JACKSONVILLE -> ST.PETERSBURG 163.1    198.2   197.1   145.9  1  7.1   14.9  11.2

TOTAL DIST = 246.7 NM          TAS @ 140 KTS
TOTAL TIME = 1 HRS: 45 MINS    DEPART @ 1230 GMT     FINAL ETA @ 14  14.9 GMT
AVG.FUEL USAGE = 17.5 GALS     FUEL RATE @ 10 GAL/HR
```

Sample run.

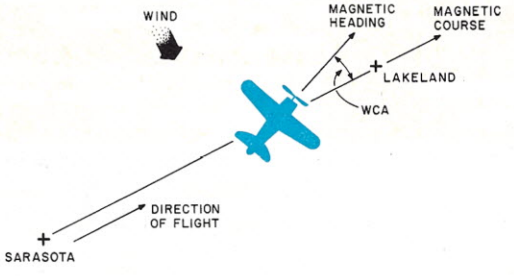


Fig. 8. Magnetic course and magnetic heading.

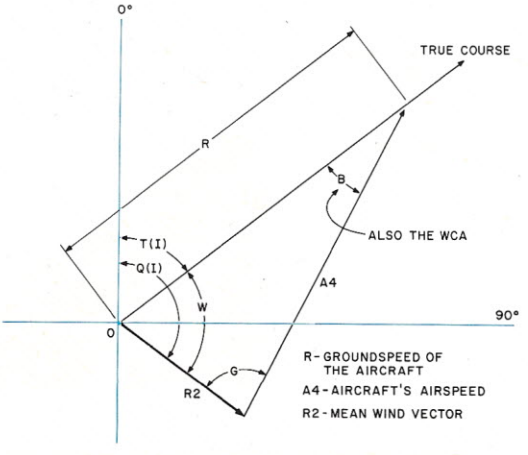


Fig. 9. Wind triangle.

cos by using Equation 5:

$$\cos(\alpha) = (b^2 + c^2 - a^2)/2*b*c$$

This equation form is used to find Q. Careful examination of the large triangle in Fig. 6 will show that all variables needed to solve Equation 5 for cos(Q) are known. This is done in line 1620.

Next we solve for R2 using an equation in the form of Equation 4. The angle Q is now the included angle, and the sides are B and R/2. But notice that only the cos of the included angle Q is needed, not the angle itself. This is why only the cos of angle Q was found. Line 1630 finds R2 where Q in the equation is actually cos(Q) found in line 1620. X1 is now derived because all three sides of the small triangle are known.

The procedure just described is a special case of vector summation for two vectors. This procedure is allowable because no more than two vectors will be summed at any one time in the program.

Wind Correction Angle

We now know in which direction to head our airplane. All we have to do when we get aloft is point the nose of the airplane in the direction we figured for the magnetic course. Right? Well, not quite. There is still something missing. What I just said would be true if there were no wind present, but this is rarely the case. When wind is blowing and you don't allow for it, you will be blown off course to an extent depending on the speed of the wind and the angle at which it hits you.

The correction for the wind will be in the form of an angle derived from the *wind triangle*. This wind triangle will use the mean wind vector already derived and will give two important pieces of information: the wind correction angle (WCA) and the ground speed of the aircraft.

Once the WCA is known it is applied to the magnetic course to derive the *magnetic heading*. This is the direction the aircraft's nose should be pointed to remain on course when winds are present. As such, this correction for winds will cause the aircraft to "crab" along its direction of flight. Refer to Fig. 8 and note the difference in heading and course.

Still following the example of travel from Sarasota to Lakeland, refer to Fig. 9. The law of sines, which will be used to derive parts of the wind triangle, can be described by Equations 6 and 7:

$$\frac{\sin(\alpha)}{a} = \frac{\sin(\beta)}{b} = \frac{\sin(\gamma)}{c} \quad \text{or} \quad \sin(\alpha) = \frac{\sin(\beta)*a}{b}$$

The equation in line 2060 is $B = (R*\sin(W))/A4$, where B is actually sin(B). Notice that this equation is the same type as Equation 7. Angle B, which is the WCA, is derived using line 2080.

Ground Speed

The next part of the wind triangle we are after (in Fig. 9) is the side R, which represents the ground speed of the aircraft. Note that this variable R is not the same as that shown in Fig. 6 and used to determine the mean wind vector in line 1610.

The equation in line 2560 can be written as R = (A4*sin(G))/sin(W). This is in the form of Equation 7.

Magnetic Heading

We now know the WCA and how it relates to the magnetic course as shown by example in Fig. 8. The next step is to have the computer find which side of the true course the WCA should be on, since this determines whether the WCA is added to or subtracted from the magnetic course. The result of this addition or subtraction will be the magnetic heading. This manipulation is handled in lines 3010–3090.

Modifications

I have only described NAVPROG in a general sense. To be more specific would require many more words and figures and would probably become tedious and boring. I hope I've explained enough so that portions of the program can be recognized and user-modified to fit particular needs.

Some of the lines in NAVPROG are checks so that the program won't blow up or derive unreasonable answers. All of these checks can be identified and changed as deemed necessary.

NAVPROG will run in my H8 system with 20K of memory, which also contains the 12K Extended Benton Harbor BASIC. More memory will be required if any sort of practical expansion is desired for the program's capability. I have ideas that I will be applying to make NAVPROG more functional and become more of a decision-oriented tool as soon as I become more familiar with the new Heath disk system recently added to my H8.

Should you desire to increase the number of stored locations, the following areas must be changed from 6 to the desired number: the dimension statements presently set at 6; the range of Q in lines 210, 4040 and 4080; the value of Q in line 4130. Also, the number of data statements must match the new number.

Should you want to change the maximum number of navigational points to a number other than 8, the dimension statements presently set at 8 must be changed to the new number, and the relation statement in line 240 must be changed. Also, line 8100, which breaks the results up into two parts for display on the TV terminal, may need changing, depending on your terminal.

My H9 has capability for only 12 lines of display, which requires the results to be displayed in two parts. If your terminal can display more lines, you may not need the two-part feature.

Although NAVPROG is self-explanatory, a few areas may

Program listing.

```
00010 PRINT TAB(29)"NAVPROG":PRINT :PRINT :GOSUB 8700
00020 CLEAR :U=57.2958:B$=CHR$(7)
00030 REM NAVPROG VER 14.4 2/16/79
00040 REM L.D.YOUNG--HDOS EBHB 100.00.00
00050 DIM C(8),T(8),V$(8),V(8),Y(8),P$(8),D(6),M(6),P1(8),P2(8),D1(6),M1(6)
00060 DIM Q(8),G(8),W(8),S(8),E(8),F(8),F1(8),A$(6),J(8),K(8)
00070 DEF FN S5(X)=SIN(X/U):DEF FN S6(X)=INT(X*10+.5)/10
00080 DEF FN S7(X)=ATN(X/SQR(1-X*X))*U
00090 DEF FN S8(X)=SIN(ABS(A/2)/U)*COS(X/U)/SIN(Q2/2)
00210 FOR Q=1TO 6:READ A$(Q),D(Q),M(Q),D1(Q),M1(Q),V$(Q),V(Q):NEXT Q
00220 PRINT
00230 INPUT "ENTER # OF NAV. POINTS (8 MAX)";N
00240 IF N<2OR N>8THEN PRINT B$:PRINT "FROM 2 TO 8 POINTS ONLY":GOTO 230
00250 IF N<>INT(N)THEN PRINT B$:PRINT "INTEGERS ONLY":GOTO 230
00260 FOR I=1TO N
00270 PRINT "USE STORED DATA FOR POINT #"I;"? (Y/N)":Y=270:Y1=290:GOSUB 8800
00280 GOTO 4000
00290 PRINT "ENTER NAME OF POINT # "I;" (13 SPACES MAX)"
00300 LINE INPUT P$(I)
00310 IF LEN(P$(I))>13THEN PRINT B$:PRINT "TOO MANY SPACES":GOTO 290
00320 PRINT "ENTER LONGITUDE OF "P$(I)" (DEG,MIN)":INPUT D,M
00330 IF D>180OR M>60OR D*60+M>10800THEN PRINT B$:GOTO 320
00340 M=M/60
00350 REM P1(I)=P$(I) LONG.
00360 P1(I)=D+M
00370 PRINT "ENTER LATITUDE OF "P$(I)" (DEG,MIN)":INPUT D,M
00380 IF D>90OR M>60OR D*60+M>5400THEN PRINT B$:GOTO 370
00390 M=M/60
00400 REM P2(I)=P$(I) LAT.
00410 P2(I)=D+M
00420 REM INPUT MAG.VAR.
00430 PRINT "IS MAG.VAR. E, W OR 0 FOR "P$(I)"?"
00440 LINE INPUT ;V$(I):IF V$(I)="0"THEN V(I)=0:GOTO 500
00450 IF V$(I)<>"E"AND V$(I)<>"W"THEN PRINT B$:GOTO 430
00460 PRINT "ENTER MAG.VAR.# NEAREST "P$(I):INPUT V(I):IF V(I)<20THEN 490
00470 PRINT B$:PRINT "IS"V(I)"DEGREES CORRECT FOR "P$(I)"? (Y/N)"
00480 Y=470:Y1=460:GOSUB 8800
00490 IF V$(I)<>"W"THEN V(I)=-V(I)
00500 NEXT I:R1=0
00510 FOR I=1TO N
00520 PRINT "DIRECTION WIND IS FROM & SPEED @ "P$(I)" (DEG,KTS)"
00530 INPUT W(I),S(I):IF S(I)=0THEN 580
00540 IF W(I)>360THEN PRINT B$:PRINT "360 DEG.MAX":GOTO 520
00550 IF S(I)>50THEN PRINT B$:PRINT "WIND > 50 KTS--RECHECK":GOTO 520
00560 IF W(I)<=180THEN W(I)=W(I)+180:GOTO 580
00570 W(I)=W(I)-180
00580 NEXT I
00590 INPUT "ENTER TAS (KTS) ";A4:IF A4>30AND A4<250THEN 620
00600 PRINT B$:PRINT "IS"A4;"KTS THE CORRECT TAS? (Y/N)"
00610 Y=600:Y1=590:GOSUB 8800
00620 INPUT "ENTER FUEL RATE (GAL/HR) ";F3:IF F3>3AND F3<50THEN 650
00630 PRINT B$:PRINT "IS"F3;"GAL/HR THE CORRECT FUEL RATE? (Y/N)"
00640 Y=630:Y1=620:GOSUB 8800
00650 INPUT "ENTER TAKE-OFF GMT (XXXX) ";H
00660 IF H>2400THEN PRINT B$:PRINT "2400 HRS MAX":GOTO 650
00670 L0=INT(H/100):L1=(H/100-L0)*100/60
00680 IF L1>1THEN PRINT B$:PRINT "60 MIN/HR ONLY":GOTO 650
00810 FOR I=1TO N
00820 A=P1(I)-P1(I+1)
00830 B1=P2(I)-P2(I+1)
00840 P=COS(P2(I)/U)*COS(P2(I+1)/U)
00850 Q=P*COS(ABS(A)/U)+COS(ABS(B1)/U)-P:IF Q<=0THEN PRINT B$:GOTO 8600
00860 Q2=ATN(SQR(1-Q*Q)/Q):Q=Q2*U*60
00870 C(I)=FN S6(Q):IF C(I)>900AND ABS(A)>30THEN PRINT B$:GOTO 8650
00880 IF C(I)=0THEN T(I)=Y(I)=E(I)=G(I)=0:R=0:GOTO 3520
01000 REM FIND TRUE CRS.
01010 S=FN S8((P2(I)+P2(I+1))/2):IF S>=1THEN 1030
01020 S=FN S7(S)
01030 IF A>0AND B1<=0THEN T=S:GOTO 1070
01040 IF A>=0AND B1>0THEN T=180-S:GOTO 1070
01050 IF A<0AND B1>0THEN T=180+S:GOTO 1070
01060 T=360-S
01070 T(I)=FN S6(T)
01300 REM FIND MAG.CRS.
01310 V1=(V(I)+V(I+1))/2
01320 V1=FN S6(V1)
01330 IF V(I)-V(I+1)>=0THEN 1370
01340 IF V(I)>=0THEN 1360
01350 V2=V(I)-V1:GOTO 1400
01360 V2=V(I+1)-V1:GOTO 1400
01370 IF V(I)<0THEN 1390
01380 V2=V1-V(I):GOTO 1400
01390 V2=V1-V(I+1)
01400 Y(I)=T(I)+V2
01500 REM GET AVG.WIND VECT.
01510 IF S(I)=0AND S(I+1)=0THEN R2=0:Q(I)=T(I):GOTO 2010
01520 W3=MIN(W(I),W(I+1)):W4=MAX(W(I),W(I+1))
01530 S3=S(I+1):S4=S(I)
01540 IF W3=W(I)THEN S3=S(I):S4=S(I+1)
01550 IF S3<>0AND S4=0THEN R2=S3/2:Q(I)=W3:GOTO 2010
01560 IF S3=0AND S4<>0THEN R2=S4/2:Q(I)=W4:GOTO 2010
01570 X=W4-W3:S1=S3*S3:S2=S4*S4
01580 IF X=0THEN R2=(S3+S4)/2:Q(I)=W3:GOTO 2010
01590 IF X=180THEN R2=0:Q(I)=T(I):GOTO 2010
```

```
01600 IF X>180THEN X=360-X
01610 R=SQR(S1+S2-2*S3*S4*COS(X/U))
01620 Q=(S2+R*R-S1)/(2*S4*R)
01630 R2=SQR((S2+(R/2)*(R/2))-2*S4*(R/2)*Q)
01640 X1=(S2+R2*R2-(R/2)*(R/2))/(2*S4*R2)
01650 X1=ATN(SQR(1-X1*X1)/X1)*U
01660 IF X>180THEN Q(I)=W4+X1:GOTO 1680
01670 Q(I)=W4-X1:GOTO 2010
01680 IF Q(I)>360THEN Q(I)=Q(I)-360
02010 W=ABS(T(I)-Q(I))
02020 IF W<=180THEN 2060
02030 IF Q(I)<T(I)THEN 2050
02040 W=360-Q(I)+T(I):GOTO 2060
02050 W=360-T(I)+Q(I)
02060 B=(R2*FN S5(W))/A4
02070 IF B>=1THEN B=90:GOTO 2510
02080 B=FN S7(B)
02510 G=180-(W+B)
02520 J=FN S5(W)
02530 IF J=0THEN R=A4+R2:GOTO 2570
02540 T=FN S5(G)
02550 IF T=0THEN R=A4-R2:GOTO 2570
02560 R=(A4*T)/J
02570 G(I)=FN S6(R):IF G(I)>50THEN 3010
02580 PRINT B$:PRINT "LOW GROUND SPEED "P$(I)" -> "P$(I+1)"...RESET"
02590 GOTO 20
03010 IF T(I)+180>360THEN 3040
03020 IF Q(I)>T(I)AND Q(I)<T(I)+180THEN 3050
03030 GOTO 3070
03040 IF Q(I)<T(I)AND Q(I)>T(I)-180THEN 3070
03050 E(I)=Y(I)-B:IF B<=Y(I)THEN 3090
03060 E(I)=360-E(I):GOTO 3090
03070 E(I)=Y(I)+B:IF E(I)<=360THEN 3090
03080 E(I)=E(I)-360
03090 E(I)=FN S6(E(I))
03510 R=C(I)/G(I)
03520 F(I)=INT(R)
03530 F1(I)=FN S6((R-F(I))*60)
03540 K(I)=FN S6(R*F3)
03550 R1=R1+R
03560 O3=INT(R1):O4=(R1-O3)
03570 L3=INT(L1+O4)
03580 L2=INT((L1+O4-L3)*600+.5)/10
03590 J(I)=L2:IF C(I)=0THEN J(I)=0
03600 IF I=N-1THEN 7010
03610 NEXT I
04000 PRINT TAB(9)"** USING STORED DATA **"
04010 PRINT "ENTER POINT #"I;" (L TO LIST)"
04020 LINE INPUT ;Y$
04030 IF Y$<>"L"THEN 4080
04040 FOR Q=1TO 6STEP 3:PRINT A$(Q)TAB(14)A$(Q+1)TAB(30)A$(Q+2):NEXT Q
04050 PRINT
04060 LINE INPUT "AGAIN? (Y/N)";Z$:IF Z$="Y"THEN 4040
04070 GOTO 4010
04080 FOR Q=1TO 6:IF Y$<>A$(Q)THEN 4130
04090 P$(I)=A$(Q):M=M(Q)/60:P1(I)=D(Q)+M
04100 M1=M1(Q)/60:P2(I)=D1(Q)+M1
04110 V$(I)=V$(Q):V(I)=V(Q)
04120 GOTO 500
04130 IF Q=6THEN 5500
04140 NEXT Q
04150 GOTO 500
05000 DATA "SARASOTA",82,33.2,27,23.8,"E",0,"VENICE",82,26,27,5,"E",1
05010 DATA "LAKELAND",82,1,27,59,"E",0,"PAHOKEE",80,42,26,47,"E",0
05020 DATA "ST.PETERSBURG",82,41.2,27,54.6,"E",0,"OCALA",82,13.4,29,10.3,"E",0
05500 PRINT B$:PRINT "NO DATA STORED/INPUT INCORRECT"
05510 PRINT "INPUT MUST BE EXACTLY SPELLED"
05520 GOTO 4010
07010 L0=INT(L0+R1+L1)
07020 IF L2=60THEN L0=L0+1:L2=0
07030 IF L0<>24OR L2<>0THEN IF L0>23THEN L0=L0-24:GOTO 7030
07040 O4=INT(O4*60+.5)
08000 REM  FORMAT
08010 O=0:O1=0
08020 PRINT TAB(30)"DIST"TAB(38)"MC"TAB(45)"MH"TAB(52)"GS";
08030 PRINT TAB(60)"ETE"TAB(68)"ETA"TAB(73)"FUEL"
08040 PRINT TAB(9)"LOCATIONS"TAB(30)"(NM)"TAB(37)"(DEG)"TAB(44)"(DEG)";
08050 PRINT TAB(51)"(KTS)"TAB(58)"(H : M)"TAB(67)"(:XX)"TAB(73)"(GAL)"
08060 FOR I=1TO N
08070 PRINT P$(I)TAB(13)"->"TAB(16)P$(I+1)TAB(29)C(I)TAB(36)Y(I)TAB(43)E(I);
08080 PRINT TAB(50)G(I)TAB(57)F(I)TAB(59)F1(I)TAB(66)J(I)TAB(72)K(I)
08090 O=O+C(I):O1=O1+1
08100 IF O1<>4THEN 8120
08110 PRINT :PRINT TAB(25)"(HIT 'RETURN' TO CONTINUE)":PAUSE
08120 IF I=N-1THEN 8140
08130 NEXT I
08140 PRINT :PRINT "TOTAL DIST ="O;"NM"TAB(30)"TAS @"A4"KTS"
08150 PRINT "TOTAL TIME ="O3"HRS:"O4"MINS"TAB(30)"DEPART @"H;"GMT";
08160 PRINT TAB(52)"FINAL ETA @"L0L2"GMT"
08170 F=R1*F3:F=FN S6(F)
08180 PRINT "AVG.FUEL USAGE ="F;"GALS"TAB(30)"FUEL RATE @"F3"GAL/HR"
08500 PRINT :LINE INPUT "REPEAT PRINT-OUT? (Y/N)";Z$
08510 IF Z$="Y"THEN 8000
08520 LINE INPUT "ANOTHER PLAN? (Y/N)";Z$
08530 IF Z$="Y"THEN 20
08540 END
08600 PRINT "DISTANCE "P$(I)" TO "P$(I+1)" EXCESSIVE.  RESET":GOTO 20
08650 PRINT "DISTANCE "P$(I)" TO "P$(I+1)" EXCESSIVE.  POSSIBLE COURSE"
08660 PRINT "ERRORS DUE TO RHUMB LINE.  RESET":GOTO 20
08700 PRINT TAB(12)"NOTE:  IF YOU PROMPT AN ERROR MESSAGE FROM THE BASIC"
08710 PRINT "INTERPRETER, YOU USUALLY MAY PROCEED BY TYPING 'CONTINUE' AND"
08720 PRINT "HITTING 'RETURN'.  THIS TYPE ERROR MESSAGE WILL BE PREDEDED BY A"
08730 PRINT "BELL AND BE OF THE FOLLOWING FORMAT -":PRINT CHR$(7)
08740 PRINT TAB(15)"! ERROR - SYNTAX ERROR AT LINE  230":PRINT
08750 PRINT "    THERE ARE OTHER ERROR MESSAGES GENERATED BY NAVPROG.  THESE"
08760 PRINT "WILL NOT ALLOW YOU TO 'CONTINUE' FROM THE POINT OF THE ERROR."
08770 RETURN
08800 LINE INPUT ;Z$:IF Z$="Y"THEN RETURN
08810 IF Z$<>"N"THEN PRINT B$:GOTO LNO(Y)
08820 GOTO LNO(Y1)
```

need clarification. The symbol → indicates the results following on the same line refer to that part of the flight going from the location preceding the symbol to the location following the symbol.

The results are given using the following terms: DIST—distance in nautical miles; MC—magnetic course in degrees; MH—magnetic heading in degrees; GS—ground speed in knots; ETE—estimated time en route in hours and minutes; ETA—estimated time of arrival at the second of the two locations indicated (given in minutes after the hour); FUEL—average gallons of fuel used en route; TAS—refers to true airspeed, which is considered as the airplane's speed through the air.

One of the peculiarities of this system is the PAUSE statement used in line 8110. You must hit the return key for program execution to continue at that point.

Conclusion

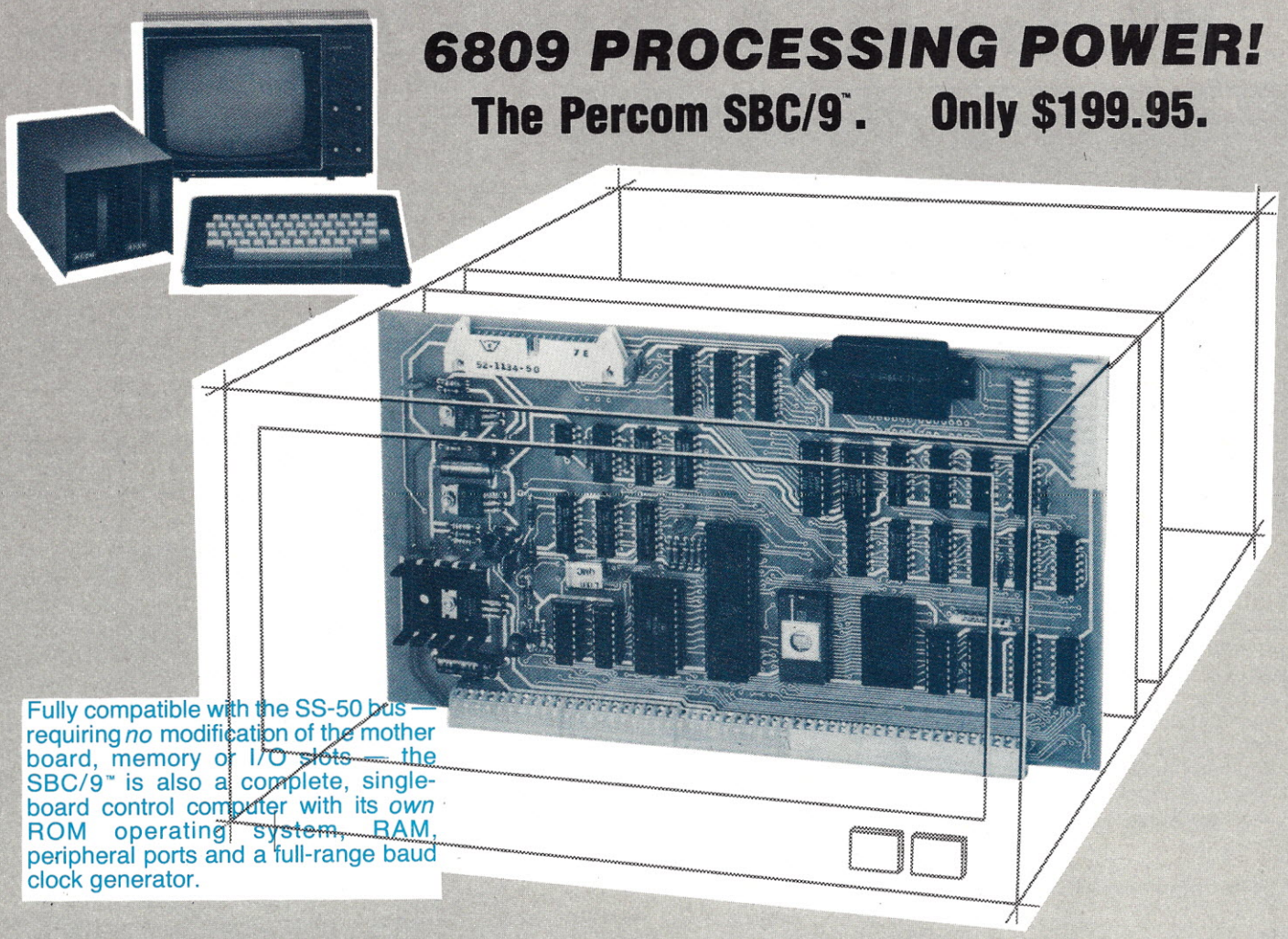
I have tried to make NAVPROG as simple as possible so that infrequent usage will not require refamiliarization by looking at notes on program functions. Also, the program has been set up to make expansion of the program easier. You will notice in line 1070 that true course T(I) is available for use if desired by the user even though it is not displayed in the results of the present program.

Finally, NAVPROG is what I consider to be a large program, but it can be analyzed as several smaller programs tied together. If you have thought about writing a program but were hesitant because you felt it would be beyond your capability, try breaking your idea down into smaller parts. After you work the smaller parts out, tie them all together. That's how I wrote NAVPROG.

Patience is also necessary. This program has taken me more than six months to write in my spare time and has involved a few trips to the Tampa Heathkit Electronic Center to use their DEC La 36 for hard copy. ■

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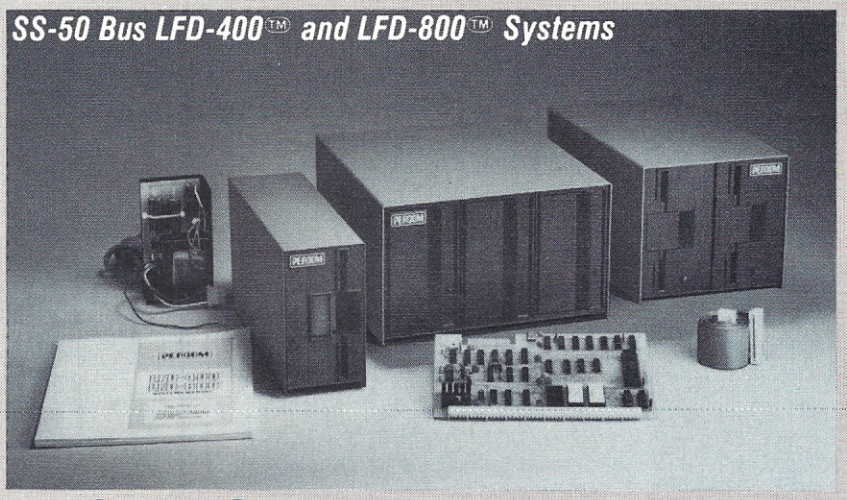
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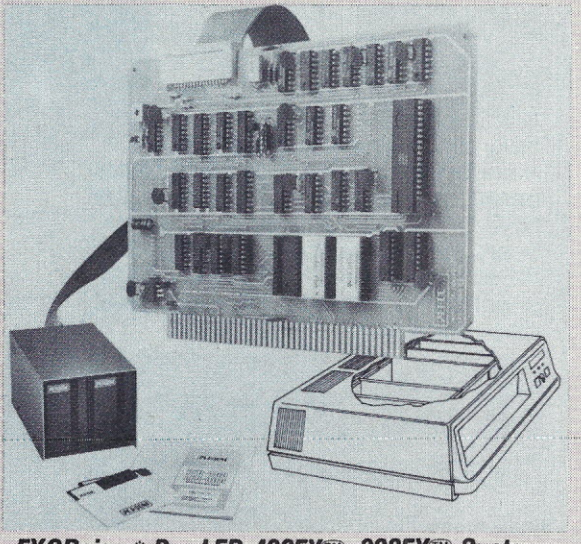
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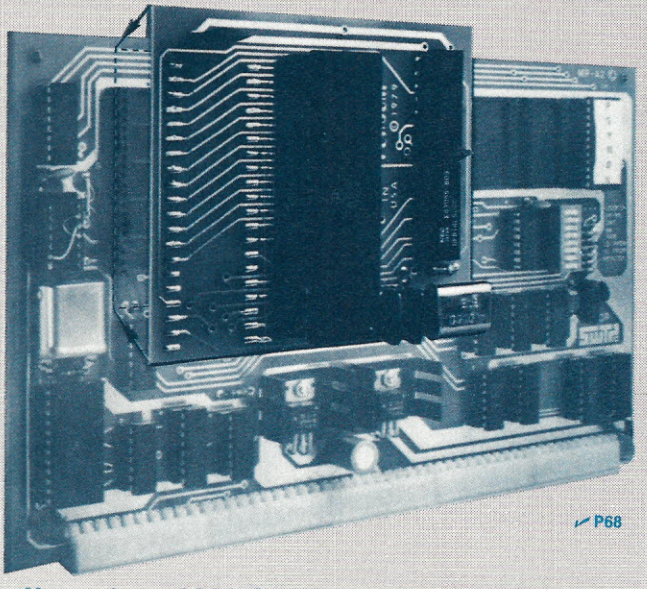
The LFD-1000™ systems (not pictured) have dual-drive units which store 800K bytes on-line. The LFD-1000™ controller accommodates two drive systems so that a user may have as much as 1.6M bytes on-line.

Mini-disk storage system prices:

MODEL	1-DRIVE SYSTEM	2-DRIVE SYSTEM	3-DRIVE SYSTEM
For the SS-50 Bus:			
LFD-400™	$ 599.95	$ 999.95	$1399.95
LFD-800™	895.95	1549.95	2195.95
For the EXORciser* Bus:			
LFD-400EX™	$ 649.95	$1049.95	$1449.95
LFD-800EX™	945.95	1599.95	2245.95
LFD-1000™	(dual) $2495.00	(quad) $4950.00	—



EXORciser Bus LFD-400EX™, -800EX™ Systems*



P68

Upgrade to 6809 Computing Power. Only $69.95

Although designed with the SWTP 6800 owner in mind, this upgrade adapter may also be used with most other 6800 and 6802 MPUs. The adapter is supplied assembled and tested, and includes the 6809 IC, a crystal, other essential components and user instructions. Restore your original system by merely unplugging the adapter and a wire-jumpered DIP header, and re-inserting the original components. Also available for your upgraded system is PSYMON™ (Percom SYstem MONitor), the operating system for the Percom 6809 single-board computer. PSYMON™ on 2716 ROM costs only $69.95. On diskette (source and object files), only $29.95.

Data Terminal & Two-Cassette Interface — the CIS-30+



P69

- Interface to data terminal and two cassette recorders with a unit only 1/10 the size of SWTP's AC-30.
- Select 30, 60 or 120 bytes per second cassette interfacing; 300, 600 or 1200 baud data terminal interfacing.
- Optional mod kits make CIS-30+ work with any microcomputer. (For MITS 680b, ask for Tech Memo TM-CIS-30+-09.)
- KC Standard/Bi-Phase-M (double frequency) cassette data encoding. Dependable self-clocking operation.
- Ordinary functions may be accomplished with 6800 Mikbug* monitor

Prices: Kit, $79.95; Assembled, $99.95. Prices include a comprehensive instruction manual. Also available: Test Cassette, Remote Control Kit (for program control of recorders), IC Socket Kit, MITS 680b mod documentation and Universal Adapter Kit (converts CIS-30+ for use with any computer).

of 6800 Microcomputing.

6800/6809 SOFTWARE

System Software

6800 Symbolic Assembler — Specify assembly options at time of assembly with this symbolic assembler. Source listing on diskette $29.95

Super BASIC — a 12K extended random access disk BASIC for the 6800 and 6809. Supports 44 commands and 31 functions. Interprets programs written in both SWTP 8K BASIC (versions 2.0, 2.2 & 2.3) and Super BASIC. Features: 9-digit BCD arithmetic, Print Using and Linput commands, and much more. Price $49.95

TOUCHUP™ — Modifies TSC's Text Editor and Text Processor for Percom mini-disk drive operation. Supplied on diskette complete with source listing $17.95

Operating Systems

INDEX™ — This easy-to-use disk-operating and file management system for 6800 microcomputers is fast. I/O devices are serviced by interrupt request. INDEX™ accesses peripherals the same as disk files — new devices may be added without changing the operating system. Other features: unlimited number of DOS commands may be added • over 60 system entry points • display only those files at or above user-specified file activity level • versions available for SWTP MF-68, Smoke's BFD-68 and Motorola's EXORciser*. Price $99.95

MINIDOS-PLUSX™ — An extension of the original MINIDOS™ for LFD-400™ mini-disk systems, MINIDOS-PLUSX™ manipulates files by six-character names. Supports up to 31 files. Resident commands include Initialize, Save, Allocate, Load, Files (directory list), Rename and Delete. Supplied on 2708 ROM with a minidiskette that includes transient utilities such as Copy, Backup, Create, Pack and Print Directory. Price . . . . . $34.95.

PSYMON™ — Percom SYstem MONitor for the Percom single-board/SS-50-bus-compatible 6809 computer accommodates user's application programs with any mix of peripherals **without** modifying programs. PSYMON™ also features character echoing to devices other than the communicating device, sophisticated register and memory dump routines and more. Price (on 2716 ROM) . . . . . $69.95.

WINDEX™ — Described in detail elsewhere on this page.

Business Programs

General Ledger — For 6800/6809 computers using Percom LFD mini-disk storage systems. Requires little or no knowledge of bookkeeping because the operator is prompted with non-technical questions during data entry. General Ledger updates account balances immediately — in real time, and will print financial statements immediately after journal entries. User selects and assigns own account numbers; tailors financial statements to firm's particular needs. Provides audit trail. Runs under Percom Super BASIC. Requires 24K bytes of RAM. Supplied on minidiskette with a comprehensive users manual. Price . . . . . $199.95.

FINDER™ — This general purpose data base manager is written in Percom Super BASIC. Works wth 6800/6809 computers using Percom LFD-400™ mini-disk drive storage systems. FINDER™ allows user to define and access records using his own terminology — customize file structures to specific needs. Basic commands are New, Change, Delete, Find and Pack. Add up to three user-defined commands. FINDER plus Super BASIC require 24K bytes of RAM. Supplied on minidiskette with a users manual. Price $99.95

Mailing List Processor — Powerful search, sort, create and update capability plus ability to store 700 addresses per minidiskette make this list processor efficient and easy to use. Runs under Percom Super BASIC. Requires 24K bytes of RAM. Supplied on minidiskette with a users manual. Price $99.95.

From the Software Works

Development and debugging programs for 6800 μCs on diskette:

Disassembler/Source Generator $30.95
Reloc'tng Disas'mblr/Segmented Text Gen $40.95
Disassembler/Trace $25.95
Support Relocator Program $25.95
Relocating Assembler/Linking Loader $55.95
SmithBUG** (2716 EPROM) $70.00

½-Price Special on Hemenway Software!

CP/68‡ disk operating system . . . . . $ 49.97
STRUBAL+‡ compiler $124.97
EDIT68 text editor . . . . . $ 19.97
MACRO-Relocating Assembler . . . . . $ 39.97
Linkage Editor (LNKEDT68) . . . . . $ 24.97
Cross Reference utility . . . . . $ 14.97

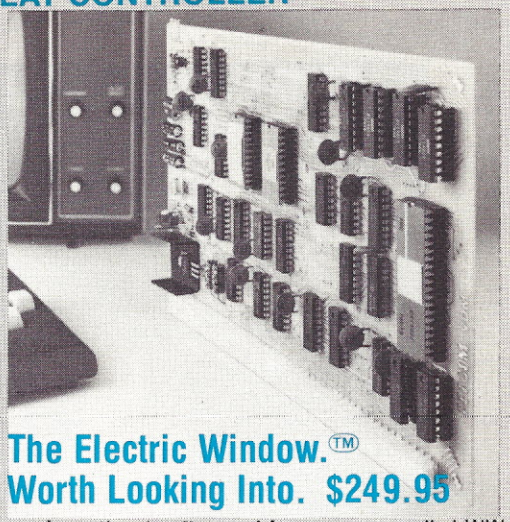
™trademark of Percom Data Company, Inc.
* trademark of Motorola Corporation
‡Trademark of Hemenway Associates Company
**SmithBUG is a trademark of the Software Works Company

P70

This programmable VIDEO DISPLAY CONTROLLER processes display changes instantly in real-time.

The Electric Window™ resides completely in main memory so control is accomplished by direct MPU access to the character-store memory and display control registers. Peer at the screen and you look right into video display memory space while you input and manipulate text — an indispensable feature for efficient screen editing and word processing. The Electric Window™. It's worth looking into. Features include:

- **Programmable CRT controller chip** that provides extraordinary versatility in software control of horizontal and vertical formatting, cursor positioning, scrolling and Start/Reset functions.
- A standard ASCII 128-unit ROM character generator which generates easy-to-read **7 x 12 dot-matrix characters with lower case descenders**. Plus . . .
- Provision for an **optional ROM** that may be programmed **for special symbols or characters**.
- Resides entirely in **2K on-board RAM** mapped into main memory.



The Electric Window.™ Worth Looking Into. $249.95

- An optional **software driver program** called WINDEX™ that complements the fast, hardware-implemented functional capability of the controller. WINDEX™ will auto-link to PSYMON™, the monitor for the Percom SBC/9™ single board computer. The ROM version of WINDEX™ costs $39.95. The minidiskette version (with source and object files) sells for $29.95.
- **Up to 24 80-character lines** — programmable.
- Program control of **display highlighting**.
- Program **interlaced or non-interlaced scan**.
- Use either **standard video monitor or modified tv**.

P71

Now Available! the SBC/9™ MPU/Control Computer

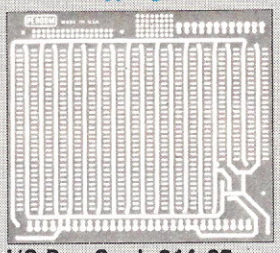
(Single-Board-Computer/6809) — stands alone as a control computer, but also compatible with the SS-50 bus for use as an MPU card. Includes PSYMON™ (Percom SYstem MONitor) in a 1K ROM and provides for additional 1K of ROM. Also includes 1K of RAM. Features: Super Port — provision for multi-address, 8-bit bidirectional data lines • an intelligent data bus for multi-level data bus decoding • an on-board 110-baud to 19.2 kbaud clock generator • extended address capability — to 16 megabytes — without disabling baud clock or adding hardware. And much more. Supplied with PSYMON™ and comprehensive users manual. Price . . . . . $199.95.

P82

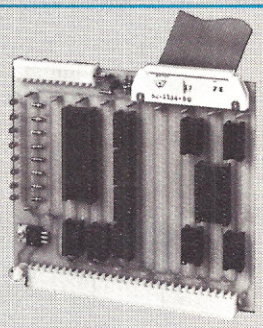
See full page ad elsewhere in this magazine for all of the SBC/9™ features.

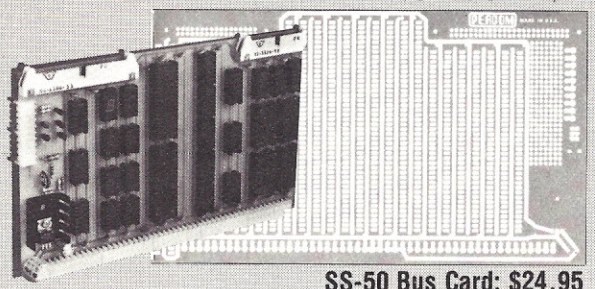
Full Feature Prototyping PC Boards

All of the features needed for rapid, straightforward circuit prototyping. Use 14-, 16-, 24- and 40-pin DIP sockets • SS-50 bus card accommodates 34- and 50-pin ribbon connectors on top edge, 10-pin Molex connector on side edge • I/O card accommodates 34-pin ribbon connector and 12-pin Molex on top edge



I/O Bus Card: $14.95





SS-50 Bus Card: $24.95

• I/O card is 1-¼ inches higher than SWTP I/O card • interdigitated power conductors • contacts for power regulators and distributed capacitance bypassing • use wire wrap, wiring pencil or solder wiring • tin-lead plating over 2-oz copper conductors wets quickly, solders easily • FR4-G10 epoxy-glass substrate.

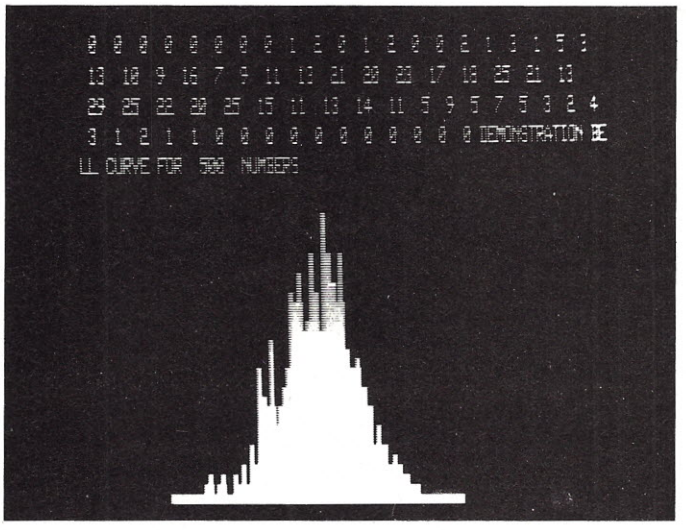
P73

To place an order or request additional literature call toll-free 1-800-527-1592. For technical information call (214) 272-3421. Orders may be paid by check, money order, COD or charged to a VISA or Master Charge account. Texas residents must add 5% sales tax.

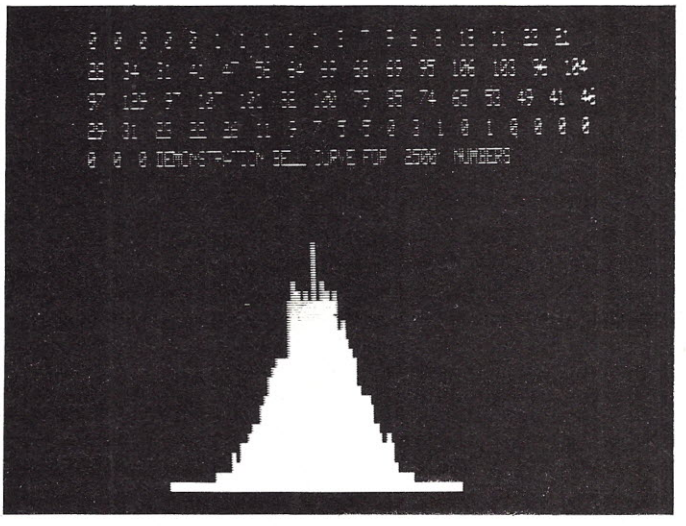
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PERCOM

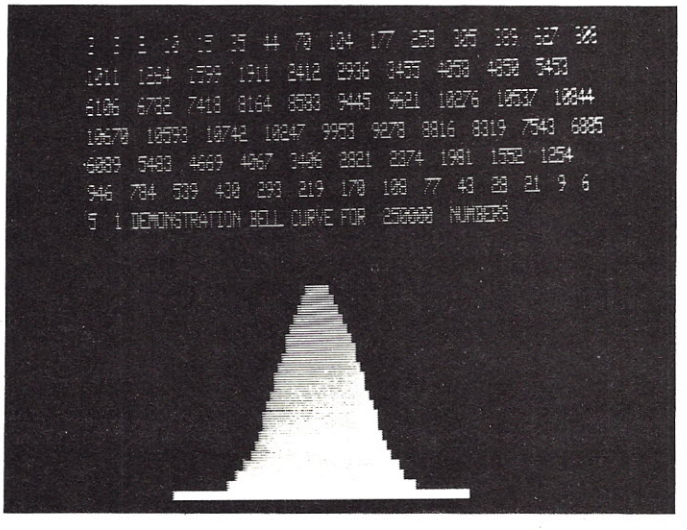
PERCOM DATA COMPANY, INC.
211 N. KIRBY GARLAND, TEXAS 75042
(214) 272-3421



Sample of 500 numbers.



Sample of 2500 numbers



Sample of 250,000 numbers.

Even More Randomness

Coverage of random numbers can never be exhausted. Here's more information.

Bertram A. Thiel
159 West Main St.
Frostburg MD 21532

Several excellent articles have recently appeared in *Microcomputing* about random numbers, their accuracy and normal distribution. The two programs given here are for the TRS-80 and have been used as a practical illustration for those interested in direct observation of randomness and normal distribution.

Listing 1 asks you for a number greater than 250 and will default to this value if a smaller number is entered. After entry, an approximate time of completion is returned to let you know if you have time to make a cup of coffee, take a shower or have a full night's sleep. The random numbers, as they are selected will follow immediately. The function RND (100) in the TRS-80 BASIC returns a random number between 1 and 100; if you use another dialect of BASIC that does not allow this, then substitute RND (n) *100. Each number that occurs is counted by incrementing the C matrix of the same number.

As you watch these numbers flying by, perhaps you will get a

feeling for what randomness is; you may find yourself looking for occurrences of the same number twice or three times in a row, or even betting with a friend on the next occurrence of quadruples. Every 1000 numbers will be followed by a statement of how far into the calculation the computer is (this is a typical anti-nail-biting subroutine). When all the numbers have been selected, they are displayed by the SET instruction after being reduced by a varying factor that is determined by your original choice of sample number. The end of the program is a loop to keep a neat display.

Hit the break key when you are ready to run it again. Try 250 samples and note the "New York skyline" effect. Then increase the number of samples in successive runs and see how long it takes to turn the skyline into a single block of concrete. The numbers at the top tell how many of each number occurred from 1 to 100, and if you try for half a million samples, you might have to eliminate line 130 in listing 1 in order to keep the numbers from running into the graph.

Normal Distribution

If you take several random numbers, say ten, and record how many times their sum repeats within a large selection, the result will be the boon to teachers (the bane of students), the normal curve, oft called "bell" because of the shape. If the theory holds true, the result will be symmetrical either side of center, in this case 50.

Listing 2 takes ten random numbers from 0 to 10 for as many times as you select at the beginning of the program, and completion time will be shown. When completed, the numbers are printed at the top, and the graph starts at 15 and ends at 85; this is to accommodate the amount of space the curve and numbers require.

Originally, I used LET N = N + RND (10) in line 120 (Listing 2), and found my curve to be centered at about 55 rather than 50. Disillusionment set in; horrors, my TRS-80 wasn't perfect! I should have known better.

After a few days of moping around the house, I retyped the program, and when I got to the RND (10) statement, it occurred to me that if you use numbers from one to ten ten times you can't possibly get anything below 10; thus my observation of the curve centered on 55 was correct—that's halfway between 10 and 100. Ah! The intricacies of statistics were starting to reveal themselves.

Run the program a few times, take a greater or lesser number of random numbers per sample or try another computer. Modify the algorithm (lines 100 to 130) by taking more or less sums of random numbers to see the changes in the final curves. What kind of changes will cause the curve to sheer to one side or to have two or more humps?

I suppose reading a book on statistics would answer these questions, but this method (trial and error) makes learning more permanent, and it's a lot more fun! ■

```
1   REM   * RANDOM NUMBER DEMONSTRATION
2   REM   * B A THIEL, FROSTBURG MD, JUNE 1979
10  CLS
15  F1=1
20  DIM C(100)
30  INPUT "ENTER NUMBER OF SAMPLES GREATER THAN 250 ";J
40  IF J<250 THEN LET J=250
50  LET T=INT(.37*(J/250)+.05)/100
60  PRINT "TIME FOR CALCULATION WILL BE";T;" HOURS"
70  FOR Y=1 TO J
80  LET F=F+1
90  IF F=1000 THEN GOSUB 270
120 LET N=RND(100)
130 PRINT N;
150 LET C(N)=C(N)+1
160 NEXT Y
170 CLS
180 FOR X=1 TO 100
190 PRINT C(X);
200 LET Y=47-C(X)/F1
210 FOR R=47 TO Y STEP-1
220 SET (X,R)
230 NEXT R
240 NEXT X
250 PRINT "DEMONSTRATION RANDOM CURVE FOR";J;" NUMBERS"
260 GOTO 260:  REM   * END OF PROGRAM
270 LET F1=F1+1
280 LET F=0
290 PRINT
300 PRINT "CURRENT COUNT IS";Y;" OF";J
310 RETURN
```

Listing 1.

```
1   REM   * NORMAL CURVE DEMONSTRATION
2   REM   * B A THIEL, FROSTBURG MD, JUNE 1979
10  CLS
20  DIM C(100)
30  INPUT "ENTER NUMBER OF SAMPLES GREATER THAN 250 ";J
40  IF J< 250 THEN LET J=250
50 LET T=INT(1.65*(J/250)+.05)/100
60  PRINT "TIME FOR CALCULATION WILL BE";T;" HOURS"
70  FOR Y=1 TO J
80  LET F=F+1
90  IF F=1000 THEN GOSUB 270
100 LET N=0
110 FOR X=1 TO 10
120 LET N=N+RND(11)-1
130 NEXT X
140 PRINT N;
150 LET C(N)=C(N)+1
160 NEXT Y
170 CLS
180 FOR X=15 TO 85
190 PRINT C(X);
200 LET Y=47-C(X)/(1+INT((J-250)/500))
210 FOR R=47 TO Y STEP-1
220 SET (X,R)
230 NEXT R
240 NEXT X
250 PRINT " DEMONSTRATION BELL CURVE FOR";J;" NUMBERS"
260 GOTO 260:  REM   * END OF PROGRAM
270 LET F=0
280 PRINT
290 PRINT "CURRENT COUNT IS";Y;" OF";J
300 RETURN
```

Listing 2.

Audio for Your Microcomputer

Use American Micro Products' MicroSounder to create sound and music with your computer.

Rod Hallen
Road Runner Ranch
PO Box 73
Tombstone AZ 85638

When asked the question, "But what can your personal computer do?" I have been known to answer, "That is limited only by my imagination!" This is perhaps a simplification of the truth, because I am also limited by my hardware. I couldn't print manuscripts and programs if I didn't have a printer; I couldn't enjoy the benefits of CP/M if I didn't have a floppy-disk system, and so forth.

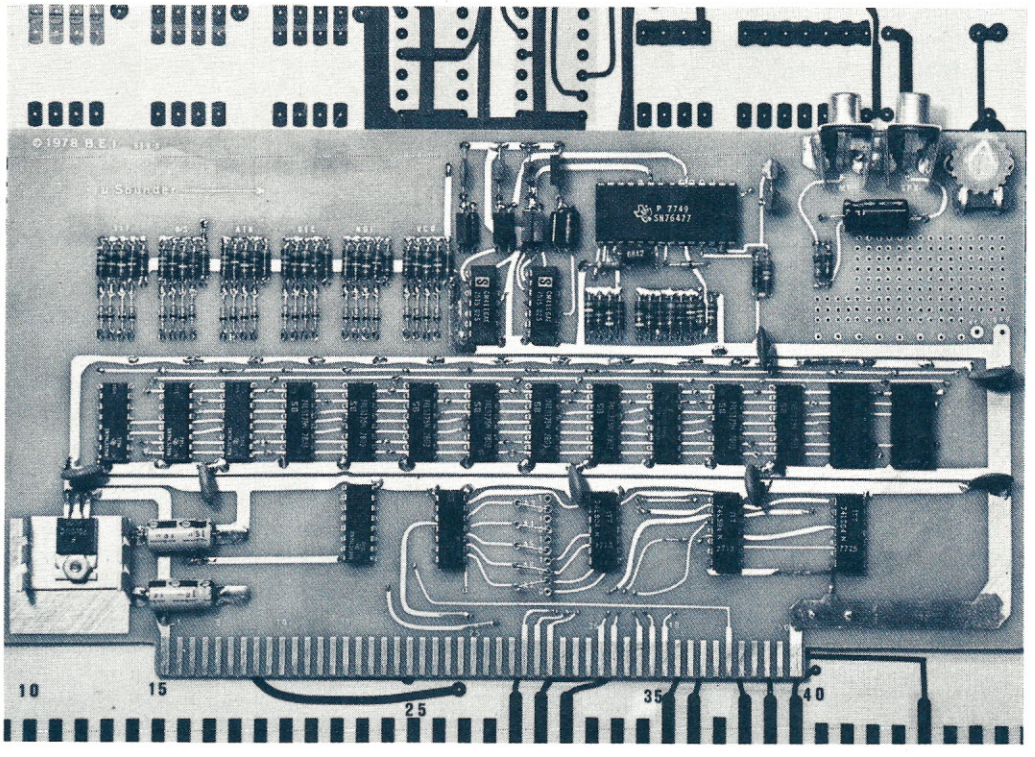
I've played with computer-generated sound quite a bit. In an article titled "Music, Music and More Music," in the November 1978 issue of *Kilobaud* (p.82), I described Software Technology's "Music System." I have also taught my computer to generate tones for various purposes.

For instance, I have one program that creates Morse code when characters are entered from the keyboard. My math tutorial program gives a two-tone wail that sounds like a European police horn when the student misses a question and a wolf whistle when he gets one right.

These effective, but relatively crude, sounds are created by toggling a data lead rapidly between 0 and 5 V dc. The result is a square wave with lots of harmonics. Contrast this to the output of the computer-controlled hardware sine wave oscillator with its comparatively clean tones that I described in an article titled "Analog and Digital Interfaces" (March 1979 *Microcomputing*, p.40).

I was, therefore, extremely interested when I first saw an advertisement for the MicroSounder S-100 sound-generating device ($179, American Micro Products, Inc., 6550 Tarnef, Houston TX 77074). It claimed that the MicroSounder could be programmed to generate sounds such as a train, explosion, siren, bird call and much more. I would have been a little skeptical, except that by coincidence I received a brochure from Texas Instruments about the same time describing their SN76477N Complex Sound IC, which is the heart of the MicroSounder.

Almost before I knew it, I had a MicroSounder, which comes completely assembled and tested, in my hands. Three minutes out of the box, it was making like a train. Credit for this extremely quick conversion goes to a two-page section at the front of the manual titled "How to Get Your New Micro-



The MicroSounder sound-generating device. Note the uncluttered layout and the "Kluge" area in the upper right-hand corner of the board. The board is shown sitting on top of the circuit design layout that created it.

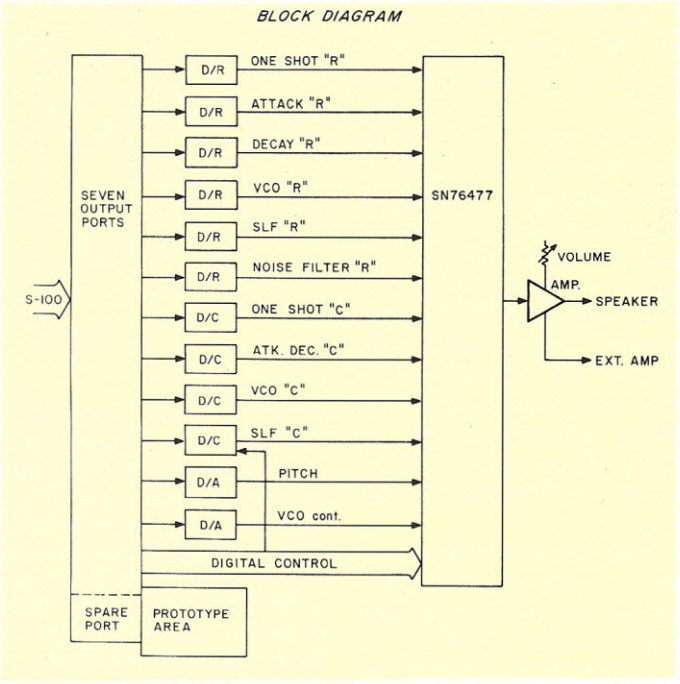


Fig. 1. Block diagram of the MicroSounder. Seven output ports control various digital latches, which control the parameters of the SN76477N as explained in the text.

Sounder Up and Running Immediately." This is an outstanding idea! You are going to spend a lot of time learning how to make the MicroSounder do exactly what you want it to do, but in the meantime you can see some immediate results.

Hardware

Before I describe what this S-100 sound-generating board can do, let's look at it from a hardware point of view. The accompanying photo shows the MicroSounder sitting on top of the pasted-up layout that was used to create the negative that was, in turn, used to create the printed circuit board. The most prominent feature on the board is the SN76477 mounted top center. My 76477 is installed in a socket and not soldered as shown, but the rest of the ICs are permanently(?) mounted on the board. I do not like soldered ICs, and that is the only real complaint that I have had with MicroSounder.

The entire center one-third of the board is taken up with SN74LS175 quad flip-flops. These latch the various resistors and capacitors that control the 76477 parameters. The vacant sockets at the right center of the board are for two more 74LS175s that you can supply if you want to implement a spare parallel output port. This is a standard latched port, which can be used to turn things on and off in time with the sound that you are creating. It can also be used as an output port completely independent from the rest of the board.

Fig. 1 is a block diagram of the MicroSounder. The D/R (digitally selected resistors), the D/C (digitally selected capacitors) and the D/A (digital-to-analog conversion) blocks are all latched and will remain constant until you change them.

Notice the holes in the upper right-hand corner of the board in the photo. This is known as a "Kluge" area, which means that you can build little circuits of your own there if you like. I have seen many other PC boards that also contained a "Kluge" area, and I always figured that it was something left over from the circuit board designer's daydreams! In any case, I've found a very good use for this area, as we shall see a little later.

The TI SN76477N

Fig. 2 is a block diagram of the 76477. There is an enormous amount of hardware packed into this chip. Trying to implement these functions with discrete components or even TTL IC logic would be like trying to replace your microprocessor in the same fashion. I don't know which generation this chip belongs to, but from now on we are going to be seeing more and more new ICs that contain entire complex functions in one chip. The new disk and video controllers are other good examples.

The basis for sound generation by the 76477 is two voltage-controlled oscillators (VCO and SLF) and a noise generator. These three sound sources can be controlled in an almost infinite number of ways. Note that the inputs to the VCO include pitch control, VCO control and also control by an external VCO or the SLF. The SLF (super low frequency) oscillator can, in turn, be controlled externally as can the noise generator.

Once sounds have been produced by these three sources, they are sent to the mixer, where any or all of them can be passed on to the envelope generator and modulator. There the envelope, which includes attack and decay control, is selected. The result is amplified and exits at audio out.

Everything that I have described in these two paragraphs is software programmable, which is the function of the 74LS175 latches mentioned earlier. This has been a necessarily brief description. The TI 76477 chapter in the MicroSounder manual consists of 38 pages and does a much better

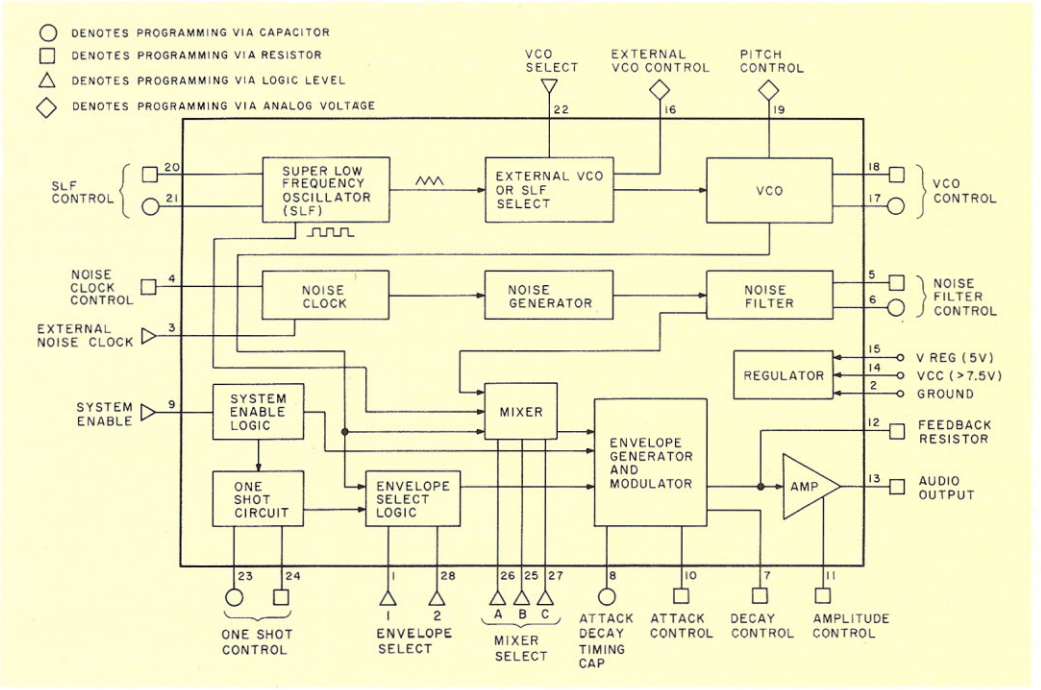


Fig. 2. Block diagram of the TI SN76477N Complex Sound Integrated Circuit. All of this is contained in one 28-pin DIP IC. In a situation where only one sound is required, each of the control leads can be hard-wired to the necessary resistor and capacitor combinations. The MicroSounder, however, controls these parameters under program control, making an infinite variety of sounds available.

Port	Bits	Function
0	0-3	One-Shot Resistor
	4-7	SLF Resistor
1	0-3	Decay Resistor
	4-7	Attack Resistor
2	0-3	VCO Resistor
	4-7	Noise Filter Resistor
3	0,1	SLF Cap.
	2,3	One-Shot Cap.
	4.5	Attack-Decay Cap.
	6,7	VCO Cap.
4	0-3	Pitch D-A converter
5	0-5	VCO Ext Cont. D-A
6	0	System Enable
	1-3	Mixer Select
	4,5	Env. Select
	6	VCO Cont. Select
	7	SLF Sync

Table 1. Functions of the seven output ports that control the MicroSounder. All of this is latched and will remain the same until you programmatically change it. Using Create to change these values one at a time, you can produce some interesting results.

```
100 OUT 0,255
110 OUT 1,0
120 OUT 2,22
130 OUT 3,137
140 OUT 4,63
150 OUT 5,0
160 OUT 6,30
```

Program 1. When this program is fed to the MicroSounder, it will produce a very realistic siren sound. Changing port 0 to a larger value will decrease the rate of change of the siren, and changing it to a smaller value will increase the rate. If your version of BASIC allows you to use statements as commands, then the program can be entered from the keyboard without line numbers, and each parameter will be set as it is typed. This program could also be implemented in 8080 or Z-80 assembly language using the OUT mnemonic.

job of explaining all of the functions and options available.

Software

Basically, the MicroSounder consists of seven parallel output ports (Fig. 1). The sounds generated are controlled by what you send to these ports. Table 1 shows what each of these ports controls. Using either assembly language or BASIC, you send values to these ports to create the sounds that you desire. The MicroSounder requires eight output ports, and on-board strapping allows you to select addresses that won't conflict with your present I/O configuration.

Program 1 will generate a siren, which will continue until you shut it off. System Enable is port 6, bit 0. An OUT 6,1 in BASIC will turn the sound off, and an OUT 6,30 will turn it back on again. Actually, any odd number to port 6 will turn the sound off, and any even number will turn it back on again, but we need the OUT 6,30 because we are also controlling other parameters with the same port.

The manual contains the port information for some other sounds and also contains four interesting BASIC programs: two games (Bomber and Space) and two programs (Work and Create) designed to help you create various sounds. Unfortunately, these programs are written in Poly BASIC, which I am not familiar with and which has some unusual statements.

After I finally figured out that PLOT is used to position the cursor and that Z = INP(1) means read one character from the keyboard, I rewrote Work and Create in Microsoft Extended Disk BASIC. I have provided American Micro Products with copies of both of these and I hope they will include them in the manual or make them available upon request, because I am sure that the use of Microsoft BASIC is much more extensive than that of Poly BASIC.

Create allows you to change various parameters of the 76477 while listening to the result. A menu that displays each of the controls listed in Table 1 and their limits is placed on the screen, and you are given the chance to change them one at a time in any desired amount. After each change, all of the values currently in effect are displayed, and you are listening to the sound that these values create.

When you are satisfied that you have the sound you want, you go to an output routine that prints the port values on the screen as shown in Table 2. This is the same siren sound as in Program 1. Note that I have addressed the board for Out ports 128 to 134. My version of Create also gives you hard copy, if desired.

Work allows you to vary all of the sound-generating parameters and also lets you store up to ten different sounds and then recall them one at a time for comparison purposes. Between these two programs you have the ability to completely control the MicroSounder and create an almost infinite variety of sounds.

In the final analysis, all of this amounts to trial and error, but I feel that with time and practice I will know approximately what values to start with in my search for a specific sound.

I did not take the time to rewrite the two games and cannot comment on them. From reading the program listings, I understand that they are audiovisual games, in which sounds are coordinated with the action on the video screen.

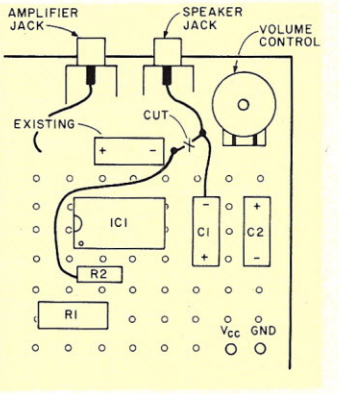


Fig. 4. My "Kluge" area now looks like this. The exact layout is not critical. This saved me the trouble of buying an amplifier or keeping my hi-fi amp in the computer room. since the on-board volume control is not readily accessible when the Z-2 is all buttoned up, I may add an external volume control at the speaker.

A Useful Mod

Note the two RCA phono connectors and the pot in the extreme upper right-hand corner on the board. One connector feeds audio to an external amplifier, and the other feeds audio from an on-board amplifier to a speaker. An external amplifier is needed because the on-board amp doesn't really provide much volume. I don't have an amplifier in my computer room, and so I began to wonder if I could build one in the "Kluge" area.

Fig. 3 is the result. This simple little IC amplifier will put out up to 2 ½ Watts, which is enough to drive me out of the house. As you can see, it only requires five components, and my total cost

Port ÷	Actual Port ÷	Value Output
0	128	255
1	129	0
2	130	22
3	131	137
4	132	63
5	133	0
6	134	30

Table 2. What the output from my version of Create looks like. These values are plugged into Program 1 to provide the desired sound. Program 1 can be used as a subroutine in any other BASIC program in which you want to use the sound that you have created.

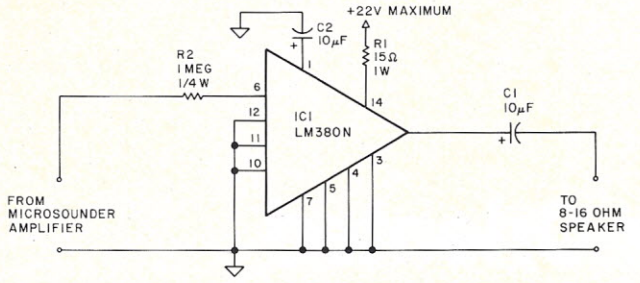


Fig. 3. The schematic for my simple 2½ Watt audio amplifier. R1 will not be needed if your + 16 volt line does not exceed about + 18 volts. Note that pins 3, 4, 5, 7, 10, 11 and 12 of the LM380N are tied together and then to ground. Any pins not shown are unused.

was under $2, which included a 14-pin wire-wrap IC socket. Make sure that you get an LM380N. There is an 8-pin DIP LM380CN available that is only rated .6 Watt.

Construction is clear-cut. I inserted the leads of the capacitors, the resistors and the wire-wrap IC socket through the holes and tied everything together on the reverse side of the board with Teflon-coated wire-wrap wire (see Fig. 4).

The + 12 volts required by the LM380 comes from a wire soldered to contact #2 on the card edge connector. This is actually unregulated and may be anywhere from + 16 volts on up, depending upon your power supply. The 380 will work with any voltage between + 8 and + 22. I inserted the 15 Ohm 1 Watt resistor in this power lead because my Z-2 runs close to + 22 volts when it is lightly loaded. The resistor drops between 2 and 4 volts depending upon the volume setting. The ground point is in the lower right-hand corner of the "Kluge" area.

Note that most electrolytic capacitors are polarized and that they should be installed as shown in the schematic. Just below the phono connector marked "SPK" there is a loop in the trace. This is our entry point. Cut the trace here (I use an old serrated kitchen knife). Then run a wire through one of the vacant holes and connect one end to the input end of R2 and solder the other end to the trace below the cut. Run another wire through a hole, connect one end to the negative side of C1 and solder the other end to the trace above the cut.

The on-board volume control still determines the amount of audio that comes out of the "SPK" jack. My original design did not include R2; however, I think that I was overdriving the LM380 input a little since more than one-quarter volume produced a lot of distortion (and an awful lot of audio!). Try experimenting with various values of R2 for the best distortion-free volume range in your situation. This will depend somewhat on the efficiency of the speaker you use.

Keep this circuit in mind the next time you need a little more audio output. It is absolutely the simplest amplifier that I have ever come across, and I have already used it in four different projects.

Conclusion

Most computer hobbyists start out with two interfaces to their computers: a keyboard and a video screen. After a while, however, a desire to control the world begins to surface. That is quite a job, but many of us are gradually moving in that direction. Using various digital and analog interfaces, you can manipulate just about any device or process that lends itself to electrical control. The MicroSounder is one more step up the ladder.

Each of us has his own likes and dislikes. What interests me might not turn you on at all. But if you are interested in creating sound and music with your computer, you ought to try the MicroSounder. I was extremely happy to add it to the growing number of boards that occupy slots in my Z-2. ■

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An Operator-Oriented Data Base Management System

Part 2 of this three-parter discusses individual BASIC programs in the system.

Last month, we examined the many features of this data base management system and discussed its operation from the user's point of view. In this installment, we begin a discussion of the individual BASIC programs in the system.

Software

All programs are written in Micropolis version 4.0 BASIC, which is essentially the same as 3.0 except for some editing functions. Most of the BASIC statements can be modified to run with almost any good disk BASIC.

My system, with its 48K of memory, provides enough memory for the programs even though I lose 2K for the display. It is necessary, however, to reduce the memory requirement for the interpreter by using the FEATURES program of the BASIC, which removes some editing features when 4.0 is used. I don't see any problems running 3.0, as these features are not incorporated into that BASIC.

In all programs, lines 300–1499 are reserved for various subroutines used in the programs. Not every subroutine is used in every program, but once a subroutine is assigned, the line numbers are used for nothing else. This is helpful when entering the program, as it is possible to move some subroutines without retyping the whole group.

The DATABASE program (see Listing 1) provides the setup for CREATE, MAINT and PROGRAMS. The SIZES statement in line 100 allocates the correct amount of memory for integer variables, real variables, strings and program size. The MEMEND statement designates the end of memory in my system. The SIZES statement is used again in line 61 of the REPORT, SORTFILE and RECOVERY programs. The functions defined in line 110 are used only with the Merlin video board and should be left out if you are not using one. These are duplicated in line 62 of the other programs.

The string statement in line 130 (line 64 in other programs) changes the string delimiter to a nonprinting character. This delimiter is used to define the end of a string to the system and should not be changed as the data in file will not read back correctly. Y$ in the same line becomes the delimiter for field data and should not be used in the data.

A third delimiter, a backslash, is used to separate some data in record 1 of the file, but this is under program control and the backslash can be used by the operator. Lines 900–907 put the date into the correct format and are duplicated in other programs. After the date is entered, PROGRAMS will be chained in and control will be passed automatically.

PROGRAMS' only function (see listing 2) is to provide a menu for program selection and act as a directory for all programs used in the system. Some programs, such as PRINT, are chained by other programs and are considered to be part of them. Therefore, these programs will not be listed in PROGRAMS.

The CREATE program (Listing 3) creates the file parameters for the data base. I have left the remarks in the listing so you can see what the subroutines are doing. Lines 300–333 are, again, peculiar to the Merlin board. Line 301 is not used in any program for the time being. Its function is to move the cursor to home. Line 302 is frequently

```
10!       *** DATABASE PROGRAM ***
20!     *** BY JOEL SHAPIRO 5/79 ***
30!
40!          FILENAME-DATABASE
50!
100 SIZES(5,3,250,8500):MEMEND16RB7FF
110 DEFFAA=16R6B9:DEFFAB=16R6C2
120 DIM B$(15,4),F$(30,30),G$(5,250),X$(30,25),Y$(30,2),X(30),Y(30),Z$(30,3)
130 STRINGCHAR$(255):Y$="|"
140 RESTORE10000:FORI=1TO15:READB$(I):NEXTI
141 GOSUB995:PRINTTAB(12)"AN OPERATOR ORIENTED":PRINTTAB(8)"DATA BASE
    MANAGEMENT SYSTEM":PRINTTAB(11)"BY JOEL SHAPIRO  1979"
142 PRINT:PRINT:PRINT
145 GOSUB800
150 FORI=1TO300:NEXTI:CHAIN"PROGRAMS"
800 PRINTTAB(12)"ENTER TODAY'S DATE":PRINTTAB(14)"ENTER \ TO END":GOSUB999:INPUTH$
810 IF LEFT$(H$,1)="\"THENEND
820 X$=H$:GOSUB900:H$=X$:PRINTTAB(15)H$:RETURN
900!   COMPOSES DATE STRING (H$)
901 X=1:FORI=1TOLEN(X$):A$=MID$(X$,I,1):IFASC(A$)<48ORASC(A$)>57THEN904
902 B$=B$+A$
903 NEXTI
904 X$(X)=B$:X=X+1:B$="":IFI<LEN(X$)THEN903
905 IFLEN(X$(3))>2THENX$(3)=RIGHT$(X$(3),2)
906 FORI=1TO3:IFLEN(X$(I))<2THENX$(I)="0"+X$(I)
907 NEXTI:X$=X$(1)+B$(7)+X$(2)+B$(7)+X$(3):RETURN
995 PRINTREPEAT$(CHAR$(13),25):RETURN
997 PRINT:INPUT"PRESS RETURN TO CONTINUE";A:RETURN
998 PRINTREPEAT$(CHAR$(13),9):RETURN
999 PRINTREPEAT$(CHAR$(13),7):RETURN
10000 DATA"\","D","N"," ",":",",","/","-","*","S",".","%","DATE","NAME","AMT."
```

Listing 1. DATABASE.

```
10!     ***DATABASE DIRECTORY ***
20!   *** BY JOEL SHAPIRO 5/79 ***
30!
40!          FILENAME-PROGRAMS
50!
80!
100 GOSUB995:PRINT"*** DATABASE DIRECTORY ***":PRINT
110 PRINT"PROGRAMS AVAILABLE":PRINT
120 PRINT" 1) CREATE, MODIFY, DELETE FILE"
125 PRINT" 2) ADD, DELETE, MODIFY FILE DATA"
130 PRINT" 3) PRINT LISTS, REPORTS, LABELS ETC."
140 PRINT" 4) SORT, CREATE INDEX FILE"
150 PRINT" 5) FILE RECOVERY PROGRAM"
200 PRINT:PRINT"ENTER NUMBER OF PROGRAM YOU WANT":INPUT"OR 0 TO END";A:IFA<1THENEND
210 ON A GOTO300,310,320,330,340
220 GOTO100
300 CHAIN"CREATE"
310 CHAIN"MAINT"
320 PLOADG"REPORT"
330 PLOADG"SORTFILE"
340 PLOADG"RECOVERY"
995 PRINTREPEAT$(CHAR$(13),25):RETURN
997 PRINT:INPUT"PRESS RETURN TO CONTINUE";A:RETURN
998 PRINTREPEAT$(CHAR$(13),9):RETURN
999 PRINTREPEAT$(CHAR$(13),7):RETURN
```

Listing 2. PROGRAMS.

used; its purpose is to clear the screen and also move the cursor to home. If your terminal has the capability, insert your own subroutine here. If not, then use a GOSUB995 and RETURN.

The subroutine at 995 will clear the screen but will not home-up the cursor, meaning that new text will be written on the lower part of the screen. Line 330 reverses the video for the line being output on the terminal, and line 331 brings it back to normal video. These are used to reverse the video for error messages only and are not really important in the operation of the system. If you have the capability in your system, write in your subroutine. Otherwise, just place a RETURN in those lines.

Lines 332 and 333 reverse the video for the entire screen and are not used in any of the programs at this time.

Note that in line 834 an INDEX statement is used. This statement returns the character position of the variable Y$.

If your BASIC doesn't have an INDEX statement, you can use a FOR-NEXT loop and a MID$ function. The file verification subroutine (lines 500-560) searches the drives for the file. If a system of more than two drives is used, the terminator in the N9 loop (line 520) should be changed. Line 996 is not used in the programs, but can be used if a clear screen function isn't available. Lines 998 and 999 serve to center text on the screen.

The statements in line 2050 reset the end of file marker and free up any tracks previously used for the file. Line 2060 sets the file attributes to Write Protect-Permanent and closes the file. Remember that the first five records of the file are used for the parameter information; they are considered part of the system rather than part of the data base.

F$(X)	Elements 1-10 used for file setup and options.
G$(X)	File data read into this array. Also used within programs for parsing and other operations.
X$(X)	Stores field titles.
Z$(X)	Stores field length.
Y$(X)	Stores D, N and S field code and operator access code.
X(X)	Stores length of field (value Z$(X)).
Y(X)	Stores pointer for beginning of field.
B$(X)	Multipurpose data.
C%(X)	Fields to be printed and their sequence.
B%(X)	Printer options.
C$(X)	Dollar format for printer.
D%(X)	Tabs for printer.
E%(X)	Fields to be totaled.
A%(X)	Sorted record numbers from sort routine.
E(X)	Running totals for fields in E%(X).

Table 1. Arrays and their purpose.

In MAINT (Listing 4), some subroutines have been added and some have been deleted. The GETSEEK statement in line 1510 sets the sequential GET pointer to record 6 of the file. The RECGET statement in the same line returns the record number that the pointer is looking at. You will notice there are similar statements for the PUT pointer. The SIZE statement returns the number of records in the file.

The basic operations concept of the MAINT program is complex but not too hard to understand. When the file is loaded, the first five records are read and are used to set up the program for correct data handling. Records 2-4 of the file have the field data originally entered in the CREATE program. The information, however, is in a composite form within a string and must be separated. This is accomplished through the subroutines effected by calling line 1000.

The titles are retained in the X$(X) array (see Table 1)—the field length in the Z$(X) array, the type code and operator access code in the Y$(X) array. From the data in the Z$(X) array, we derive a set of pointers that are retained in the Y(X) array. The pointer carries the starting position for each field's data in the data string and is used to locate the data correctly for use by the program. By using the pointer instead of a delimiter, we are able to access the correct data directly, instead of parsing the string each time we need it. This saves considerable time in all programs.

In order to accomplish this it is necessary that we fill out the field with blanks before the string is assembled and written to file. Lines 2100 and 2110 show how this is done. When data is added, modified or coded for deletion, the current data is written into the file (F$(8)) (see Table 2), so the data of the last update is recorded. This information is, of course, part of the file handling.

The first character position in all data strings is used for a delete marker. The delete marker is an asterisk (B$(9)) (see Table 3) in the programs. With the exception of the edit routine in MAINT and the SORTFILE program itself, the delete marker will prevent the display or printing of

Listing 3. CREATE.

```
10!   CREATE FILE PROGRAM
20!     *** BY JOEL SHAPIRO 5/79 ***
30!
40!          FILENAME-CREATE
50!
70 A$="":A=0:GOSUB926:GOSUB924:GOSUB925
80 GOSUB995:PRINT"*** CREATE, MODIFY, DELETE FILES ***":PRINT:PRINT"FUNCTIONS AVAILABLE":PRINT
81 PRINT" 1) CREATE NEW FILE":PRINT" 2) INITIALIZE FILE TO ZERO"
82 PRINT" 3) MODIFY FILE PARAMETERS":PRINT" 4) DISPLAY FILE PARAMETERS"
83 PRINT" 5) DISPLAY NUMBER OF RECORDS":PRINT" 6) REMOVE FILE FROM DATA BASE"
84 PRINT" 7) DUPLICATE FILE PARAMETERS"
85 PRINT" 8) OPEN"
86 PRINT" 9) OPEN"
87 PRINT"10) RETURN TO PROGRAM DIRECTORY"
90 PRINT:INPUT"SELECT FUNCTION YOU WISH";A:A=INT(A):IFA<1ORA>10THEN80
95 ONAGOTO1500,2000,2200,2100,3000,3200,3400,4000,5000,9000
300!   MERLIN S/R POKE(16R690)=ASC($) OR VARIABLE
302 POKE(16R&BB)=65:D=FAA:POKE(16R&BB)=41:D=FAA:RETURN
330 POKE(16R64E)=16R80:RETURN
```

```
331 POKE(16R64E)=16R00:RETURN
400!   WARNING MESSAGE-DATA DELETION
401 GOSUB302:GOSUB999:GOSUB996
402 PRINT:PRINT"THIS WILL DELETE DATA":PRINT"ARE YOU SURE ?":PRINT:GOSUB996:GOSUB990
403 IFA$="Y"THENRETURN
404 GOTO80
500!   FILE VERIFICATION S/R
502 IFA3=1THENGOSUB995:PRINT"SAME FILE?":GOSUB998:GOSUB990:IFA$="Y"THENRETURN
510 GOSUB995:PRINT"ENTER NAME OF FILE":PRINT"OR \ TO END":GOSUB999:INPUTN$:IFN$=B$(1)THENA3=0:GOTO614
520 FORN9=0TO1:A$=MID$(STR$(N9),2,1):OPEN1A$+":"+N$ ERROR540
530 N$=A$+":"+N$:CLOSE1:A3=1:RETURN
540 IFERR=40RERR=7THENNEXTN9
550 GOSUB995:PRINTERR$:PRINT"STOPPED":PRINT"MAKE CORRECTION":GOSUB999:GOSUB997:GOTO500
560 GOTO510
600!   ERROR AND OTHER MESSAGES
601 GOSUB330:PRINT"EXCEEDED MAXIMUM LENGTH FOR FIELD TITLE":PRINT"MAXIMUM LENGTH-18 CHARACTERS":GOSUB331:RETURN
602 GOSUB330:PRINT"EXCEEDED MAXIMUM RECORD SIZE-LIMIT 248":PRINT"CHARACTERS!  RE-ENTER ALL DATA":GOSUB331:RETURN
603 GOSUB330:PRINT"ILLEGAL INPUT!  RE-ENTER":GOSUB331:RETURN
604 GOSUB330:PRINT"ALPHABETICAL CHARACTERS IN NUMERICAL ":PRINT"FIELD.  ENTER CORRECT DATA":GOSUB331:RETURN
605 GOSUB330:PRINT"ILLEGAL RECORD NUMBER":GOSUB331:RETURN
606 GOSUB330:PRINT"EXCEEDED MAXIMUM NUMBER OF FIELDS":PRINT"30 FIELD LIMIT":GOSUB331:RETURN
607 GOSUB998:PRINTTAB(10)"PROCESSING DATA":GOSUB999:RETURN
608 GOSUB998:PRINTTAB(10)"SEARCHING-WAIT":GOSUB999:RETURN
609 GOSUB998:PRINTTAB(8)"WRITING TO DISK-WAIT":GOSUB999:RETURN
611 GOSUB330:PRINT"EXCEEDED 30 CHARACTER LIMIT":GOSUB331:RETURN
612 CLOSE1:GOSUB330:PRINT"DISK ERROR!":PRINTERR$:GOSUB331:GOSUB997:RETURN
613 PRINT"ENTER NUMBER OF FIELD YOU WISH TO":INPUT"CHANGE OR 0 FOR NONE";A:A=INT(A):RETURN
614 GOSUB330:PRINT"DISCONTINUE PROGRAM":GOSUB331:FORI=1TO300:NEXTI:GOTO80
760!   PRINT D,N+OR S CODE-OPERATOR ACCESS CODE
761 X=35:A$=LEFT$(Y$(I),1):IFA$="D"ORA$="N"ORA$="S"THENPRINTTAB(X)A$;TAB(X+3)RIGHT$(Y$(I),1):RETURN
762 PRINTTAB(X)" ";TAB(X+3)RIGHT$(Y$(I),1):RETURN
800!   BUILD G$ (2-4)
801 FORI=2TO4:G$(I)="":NEXTI:GOSUB607
802 R1=2:FORI=1TO30:IFI>10THENR1=3
803 IFI>20THENR1=4
804 G$(R1)=G$(R1)+X$(I)+B$(1)+Z$(I)+Y$(I)+Y$
805 NEXTI:RETURN
810!   BUILD G$(1)
812 FORI=1TO30:G$(1)=G$(1)+F$(I)+Y$:NEXTI:RETURN
830!   PARSE G$(R1)
831 IFI>10THENR1=3
832 IFI>20THENR1=4
834 J=LEN(G$(R1)):X=INDEX(G$(R1),Y$):IFX=0THEN838
836 G$=LEFT$(G$(R1),X-1):G$(R1)=RIGHT$(G$(R1),J-X)
838 RETURN
840!   PARSE G$ (TITLE, FIELD, CODE)
844 X=01Y$(I)=RIGHT$(G$,2):G$=LEFT$(G$,LEN(G$)-2)
846 X=INDEX(G$,B$(1)):X$(I)=LEFT$(G$,X-1)
848 Z$(I)=MID$(G$,X+1,LEN(G$)-X)
849 RETURN
921 FORI=1TO30:Z$(I)="":NEXTI:RETURN
922 FORI=1TO30:X$(I)="":NEXTI:RETURN
923 FORI=1TO30:Y$(I)="":NEXTI:RETURN
924 FORI=1TO5:G$(I)="":NEXTI:RETURN
925 FORI=1TO30:F$(I)="0":NEXTI:RETURN
926 FORI=1TO30:Y$(I)="":Z$(I)="":X$(I)="":NEXTI:RETURN
990 INPUT"( Y OR N )";A$:IFA$<>"Y"ANDA$<>"N"THEN990
991 RETURN
995 PRINTREPEAT$(CHAR$(13),25):RETURN
996 PRINTREPEAT$(CHAR$(61),39):RETURN
997 PRINT:INPUT"PRESS RETURN TO CONTINUE";A:RETURN
998 PRINTREPEAT$(CHAR$(13),9):RETURN
999 PRINTREPEAT$(CHAR$(13),7):RETURN
1000!   DISPLAY RECORD #1
1001 PRINTTAB(10)"RECORD #1":L=0:FORI=1TO30:PRINTI;TAB(6)F$(I)
1002 IFI=1#150RI=2#15THENGOSUB997:PRINTTAB(10)"RECORD #1"
1003 NEXTI:RETURN
1010!   DISPLAY RECORDS 2-4 TITLE DATA
1011 FORI=1TOVAL(F$(2))
1012 IFI=1THENPRINTTAB(10)"RECORD #2"
1013 IFI=11THENPRINTTAB(10)"RECORD #3"
1014 IFI=21THENPRINTTAB(10)"RECORD #4"
1015 PRINTI;TAB(6)X$(I);TAB(25)Z$(I);:GOSUB760
1017 IFI=15THENGOSUB997
1018 NEXTI:GOSUB997:RETURN
1020!   DISPLAY RECORD #5
1021 PRINTTAB(10)"RECORD #5":IFG$(5)=""ORG$(5)="0"THENPRINT"1  NOTHING IN RECORD #5":GOTO1023
1022 PRINT"1  ";G$(5)
1023 GOSUB997:RETURN
1100!   READ RECORDS 1-5 FROM FILE
1101 FORI=1TO5:GETIRECORDIG$(I):NEXTI:RETURN
1110!   READ G$(1-5)FROM FILE:LOAD ARRAYS
1112 GOSUB1100:GOSUB607:R1=1:FORI=1TO30:GOSUB834:F$(I)=G$:NEXTI
1114 R1=2:FORI=1TOVAL(F$(2)):GOSUB830:GOSUB840:NEXTI
1119 RETURN
1300!   WRITE G$ (1-5) TO DISK
1301 FORI=1TO5:PUTIRECORDIG$(I):NEXTI:RETURN
```

deleted entries. The delete routine in DELETE will key itself to the marker when deleting data.

The DELETE program (Listing 5) is chained from the MAINT program and is considered part of MAINT. Two options are available in the program: transfer coded data from the master file to another file before deleting from the master file or just delete the data from the master file.

Using the first option requires the structure of the receiving file to be exactly that of the master file. This is most easily accomplished by using the duplicate file parameters utility in the CREATE program.

The DELETE program allows the coded data to be transferred before the file is restacked, because the data will be lost once the restacking takes place. When the data is transferred, it is added sequentially to the receiving file. This means it will not occupy the same record that it did before. When the master file is restacked, the data will also have been moved to different records, so both files will have to be sorted individually if a sorted report is required.

We have now discussed five of the nine BASIC programs that make up the data base management system. Next month, we'll conclude this three-part article by looking at the programs that sort the data and generate the printed reports. ■

F$(1)	File code.
F$(2)	Number of data fields.
F$(3)	Number of entries coded for deletion.
F$(4)	Fields and sequence for report.
F$(5)	Printer options.
F$(6)	File create date.
F$(7)	Special filename/purpose.
F$(8)	Date last update.
F$(9)	Fields for totals in report.
F$(10)	Reserved.
F$(11)-F$(30)	Available for programs.

Table 2. F$ array details.

B$(1)	Backslash (char 92)
B$(2)	D
B$(3)	N
B$(4)	Space (char 32)
B$(5)	:
B$(6)	,
B$(7)	/
B$(8)	-
B$(9)	*
B$(10)	S
B$(11)	.
B$(12)	%
B$(13)	Date
B$(14)	Name
B$(15)	Amt.

Table 3 B$ array details

THE VERY BEST.



If you're serious about your TRS-80 computer, try these disk based programs. When it comes to hardcore software, noboby does it like **TBS.**

BUSINESS MAIL SYSTEM by Dale Kuber is designed for large-scale business users. Requiring 32K, two disks and printer, this program will store up to 150,000 names in a single file spread out over multiple disks. Each data disk holds 500 names. After data entry, **BMS** automatically sorts the data by zip code and alphabetical order within the zip code. The program tells you when and which data disk to insert, expanding your files automatically until you've reached 300 disks. Data is input directly onto formatted screen display with the option to use Company Name/Attention instead of Last Name/First Name. Three numeric and one alpha code fields are provided to help you use the search and printout mode. **BUSINESS MAIL SYSTEM** allows you to program the number and spacing of your labels and then print out and read your data disks concurrently using accelerated printing. (This mode works only with Centronics printers.) With more features than can be described here, this high-powered program sells for $125.00.

ANALYSIS PAD by Del Jones is the epitome of first-class programming in business applications. Requiring 48K, and one disk with a printer recommended, this columnar calculator gives the user tremendous flexibility in data entry enabling the user to create 30 or more columns and rows. Enter your own column and row labels. Enter your data by row or column or directly onto screen display via edit mode. Move, swap, delete, and add rows or columns. Create new pads by stripping relevant data from old files. You never have to key in data twice. But more important than the powerful data manipulation provided, you can add, subtract, multiply and divide one column by another and put results in another column. You can perform up to six calculations on one column and even define one column to be a constant. The calculation routine you create can be saved and reused. Print out the entire pad in four column segments to line or serial printer. **ANALYSIS PAD** was originally advertised for 32K tape at $32.50. Since then it has been totally rewritten and expanded to its present 48K disk only form and sells for $49.50. It is easily worth twice as much. You have to see it to believe it.

DATA MANAGER by Dale Kubler starts out where INFORMATION SYSTEM leaves off. Requiring 32K and one disk, it accepts up to ten user-defined fields with up to forty characters per field and 255 characters per record. As with all TBS software, data entry and editing is professional and simple to use. What makes this program stand apart from "in-mem" data managers is that it uses up to four disks on line as memory, or as much as 320K of memory storage. Because disk sorts take more time than in-mem sorts, **DATA MANAGER** enables the user to create and maintain up to 5 "key" sort files for quick access of data. A utility program is provided to calculate the number of records possible since the amount of records you can maintain is dependent on a number of variables. This program also supports the upper/lower case modification, and printouts can be programmed to almost any format and sent to line or serial printer. For Centronic printers, accelerated printing is provided enabling the computer to search and print at the same time. If you already have INFORMATION SYSTEM, **DATA MANGER** will accept those files. (We are currently working on a program that will merge your data files with Electric Pencil files.) A necessity for organized people, this program sells for $49.50.

CHECK REGISTER ACCOUNTING SYSTEM, adapted for the TRS-80 by Dale Kubler and originally written by O.E. Dial, is the most comprehensive check-balancing program written. Requiring 32K, two disks and printer, this program does much more than just balance and reconcile your checkbook. It enables you to define up to 60 account names and will generate monthly summaries of all accounts with monthly and year-to-date totals. Single-entry input allows the user to disperse one transaction over several accounts and to make a 64-character note on each transaction. Checks can be printed out after data has been entered. Aside from the Statement of Accounts, **CRAS** also generates the following reports: Check Register for any Month, Notes to Check Register, Income/Expense Distribution, Statement of Selected Accounts, Bank Reconcile Statement and Suspense File. The Suspense file is an extra feature where you can make notes to yourself for any month in the year. **CRAS** will make both you and your accountant happy and it sells for $49.50.

TBS has other great software for your TRS-80. **BASIC TOOLKIT, SYSTEM DOCTOR & TERMINAL CONTROL** are system utilities. **CHECKBOOK II, INFORMATION SYSTEM & EXERCISER** are general applications. Don't forget the **LIBRARY 100;** 100 programs for only $49.50. **TBS** also has **DISK HEAD CLEANERS** for **TRS-80** and **APPLE** and **GRAN MASTER DISKETTES,** the best on the market.

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✓ Reader Service index—page 241

```
1500!    CREATE NEW FILE
1510 E1=0:GOSUB302:PRINT"HOW MANY FIELDS WILL YOU USE ?"
1520 PRINT"UP TO 30 FIELDS ARE ALLOWED":PRINT:INPUT"FIELDS";F$:IFF$=B$(1)THEN614
1530 FORK=1TOLEN(F$):L=ASC(MID$(F$,K,1)):IFL<48ORL>57THENGOSUB604:GOTO1520
1540 NEXTK
1550 N=INT(VAL(F$)):F$(2)=F$:IFN<10RN>30THENGOSUB606:GOTO1520
1560 GOSUB9241:R1=2:FOR I=1TON:GOSUB302
1570 J$="":PRINT"TITLE FOR FIELD";I;:INPUTF$
1580 IFLEN(F$)>18THENGOSUB601:GOTO1570
1590 IFLEFT$(F$+4)=B$(13)THENE$="8":GOTO1610
1600 PRINT:PRINT"SIZE OF FIELD";I;:PRINT"(SPACE FOR 248-E1)";"CHARACTERS)":INPUTE$
1610 E=VAL(E$):E1=E1+E:IFE1>248THENGOSUB602:E1=E1-E:GOTO1600
1620 FORK=1TOLEN(E$):L=ASC(MID$(E$,K,1)):IFL<48ORL>57THENGOSUB604:GOTO1600
1630 NEXTK:IFLEN(F$)>=4THENJ$=LEFT$(F$,4):IFJ$=B$(13)ORJ$=B$(14)THENJ$=B$(10):GOTO1670
1640 IFJ$=B$(15)THENJ$=B$(2):GOTO1670
1650 PRINT:PRINT"STRING, NUMERICAL OR DOLLAR FIELD":INPUT"ENTER (S, N OR D)";J$:IFLEN(J$)>1THENGOSUB603:GOTO1650
1660 D$="":IFJ$<>B$(2)ANDJ$<>B$(3)ANDJ$<>B$(10)THENGOSUB603:GOTO1650
1670 PRINT:PRINT"IS FIELD FOR OPERATOR INPUT?":GOSUB990
1680 IFA$="Y"THEND$=B$(9)
1690 IFA$="N"THEND$=B$(8)
1700 X$(I)=F$:Y$(I)=J$+D$:Z$(I)=E$
1710 NEXTI:GOSUB302:A5=0
1720 GOSUB302:PRINTTAB(15)"FIELDS":GOSUB1010
1730 PRINT"THESE ARE THE FIELDS NAMED":IFA5=1THENRETURN
1740 PRINT"ARE THEY O.K.?":GOSUB990:IFA$="Y"THEN1820
1750 GOSUB302:A5=1:GOSUB1720:INPUT"FIELD TO BE CHANGED";I:IFI<1ORI>VAL(F$(2))THEN1750
1760 GOSUB302:PRINTI;TAB(4)X$(I);TAB(25)Z$(I);:GOSUB760:PRINT
1770 INPUT"ENTER TITLE";X$(I):INPUT"ENTER FIELD LENGTH";Z$(I):D$=RIGHT$(Y$(I),1):Y$(I)=LEFT$(Y$(I),1)
1780 INPUT"ENTER D, N OR S";Y$(I):IFY$(I)<>B$(2)ANDY$(I)<>B$(3)ANDY$(I)<>B$(10)THENGOSUB603:GOTO1780
1790 PRINT"ENTER * FOR OPERATOR INPUT CODING OR":INPUT"- FOR NO OPERATOR INPUT";D$
1800 Y$(I)=Y$(I)+D$
1810 A5=0:GOSUB302:GOTO1720
1820 GOSUB800
1830 GOSUB302:PRINT"ENTER NUMERICAL FILE CODE OR ACCESS":PRINT"KEY IF DESIRED":INPUTF$(1)
1840 IFLEN(F$(1))>30THENGOSUB611:GOTO1830
1850 PRINT:PRINT"ENTER SPECIAL FILENAME OR DESCRIPTION":INPUT"IF DESIRED";F$(7)
1860 IFLEN(F$(7))>30THENGOSUB611:GOTO1850
1870 PRINT:INPUT"NAME OF NEW FILE";INPUTN$
1880 PRINT:INPUT"DISK DRIVE # FOR FILE";A$
1890 N$=N:+A$+":"+N$:GOTO1920
1900 GOSUB998:PRINT"DISK ERROR":PRINTERR$
1910 GOSUB997:GOTO1870
1920 OPEN1N$ERROR1900:F$(3)="O":F$(6)=H$:GOSUB810:GOSUB995:GOSUB609:GOSUB999:GOSUB1300
1930 ATTRS(1)=3:CLOSE1:GOSUB998:PRINT"NEW FILE CREATED":GOSUB999:GOSUB997
1940 GOSUB998:PRINT"DO YOU WISH TO CREATE ANOTHER FILE":GOSUB990:IFA$="Y"THENA3=0:GOTO1500
1950 GOTO80
2000!    INITIALIZE FILE TO ZERO
2010 GOSUB302:PRINT"INITIALIZE FILE TO ZERO":PRINT"RETAINS ORIGINAL PARAMETERS":PRINT
2020 GOSUB400:GOSUB500:OPEN1N$ERROR2090:ATTRS(1)=0:GOSUB1100
2030 GOSUB607:J=1:R1=1:FORI=1TO30:GOSUB834:F$(1)=G$:NEXTI
2040 F$(6)=H$:F$(8)="":GOSUB810:GOSUB609:GOSUB1300
2050 EOF(1)=6:IFTRACKS(1)>1THENFREESPACE1
2060 ATTRS(1)=3:CLOSE1
2070 GOSUB302:PRINT"DO YOU WANT TO INITIALIZE MORE FILES":GOSUB990:IFA$="Y"THENA3=0:GOTO2000
2080 GOTO80
2090 GOSUB995:GOSUB612:GOSUB997:GOSUB302:GOTO2020
2100!    DISPLAY FILE PARAMETERS
2110 A5=0:GOSUB302:GOSUB500:OPEN1N$ERROR2170:GOSUB924:GOSUB925:GOSUB1100:GOSUB1110
2120 GOSUB302:GOSUB1000:GOSUB302:GOSUB1010:GOSUB302:GOSUB1020:IFA5=1THEN2140
2130 CLOSE1
2140 GOSUB302:PRINT"DO YOU WANT TO REVIEW SAME FILE AGAIN":GOSUB990:IFA$="Y"THENR1=1:A5=1:GOTO2120
2150 PRINT:PRINT"DO YOU WANT TO REVIEW ANOTHER FILE":GOSUB990:IFA$="Y"THENA3=0:GOTO2100
2160 GOTO80
2170 GOSUB612:PRINT"CORRECT AND":GOSUB997:A3=0:GOTO2110
2200!    MODIFY FILE PARAMETERS
2210 GOSUB302:GOSUB500:OPEN1N$ERROR2330:ATTRS(1)=0:GOSUB924:GOSUB925:GOSUB1100:GOSUB1110
2220 GOSUB302:PRINT"ENTER RECORD NUMBER (1 TO 5) FOR":PRINT"MODIFICATION OR 0 FOR DISPLAY OF ALL"
2230 INPUT"RECORD NUMBER";R:IFR>5THEN2220
2240 IFR=0THENGOSUB302:GOSUB1000:GOSUB302:GOSUB1010:GOSUB302:GOSUB1020:GOTO2220
2250 IFR=1THENGOSUB302:GOSUB1000:GOTO2280
2260 IFR>1ANDR<5THENGOSUB302:GOSUB1010:GOTO2280
2270 GOSUB302:GOSUB1020
2280 PRINT:PRINT"IS THIS THE CORRECT RECORD":GOSUB990:IFA$="N"THEN2220
2290 ONRGOTO2300,2340,2340,2340,2500
2300 GOSUB302:GOSUB1000:GOSUB613:IFA=0THEN2540
2310 GOSUB302:PRINTA;TAB(4)F$(A):INPUT"NEW INPUT";F$(A):IFLEN(F$(A))>30THENGOSUB611:GOTO2310
2320 GOTO2300
2330 GOSUB612:PRINT"CORRECT AND":GOSUB997:A3=0:GOTO2210
2340 GOSUB302:GOSUB1010:GOSUB613:GOSUB302:IFA=0THEN2540
2350 PRINT"FIELD";A;:PRINT:PRINT"TITLE":PRINTX$(A)
2360 INPUT"NEW INPUT";X$(A):IFLEN(X$(A))>18THENGOSUB601:GOTO2350
2370 E1=0:PRINT:PRINT"FIELD LENGTH":PRINTZ$(A):INPUT"NEW INPUT";Z$(A)
2380 FORK=1TOLEN(Z$(A)):L=ASC(MID$(Z$(A),K,1)):IFL<48ORL>57THENGOSUB604:GOTO2370
2390 NEXTK
2400 FORJ=1TOVAL(F$(2)):E1=E1+VAL(Z$(J)):IFE1>248THENGOSUB602:GOTO2370
2410 NEXTJ
```


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```
2420 PRINT:PRINT"FIELD CODE":K$=LEFT$(Y$(A),1):PRINTK$:INPUT"NEW INPUT";K$
2430 IFK$<>B$(2)ANDK$<>B$(3)ANDK$<>B$(10)THENGOSUB603:GOTO2420
2440 D$=RIGHT$(Y$(A),1):PRINT:PRINT"OPERATOR INPUT CODE":PRINTD$
2450 PRINT"ENTER * FOR OPERATOR INPUT OR - FOR NO":PRINT"OPERATOR INPUT":INPUTD$
2460 IFD$<>B$(8)ANDD$<>B$(9)THENGOSUB603:GOTO2440
2470 IFA>VAL(F$(2))THENF$(2)=STR$(VAL(F$(2))+1)
2480 Y$(A)=K$+D$
2490 GOTO2340
2500 GOSUB302:GOSUB1020:GOSUB613:IFA=0THEN2540
2510 GOSUB302:PRINTG$(5)"INPUT"NEW INPUT";G$(5)
2520 IFLEN(G$(5))>248THENGOSUB602:GOTO2510
2530 GOTO2500
2540 GOSUB302:PRINT"MORE RECORDS TO CHANGE":GOSUB990:IFA$="Y"THEN2220
2550 GOSUB607:GOSUB800:GOSUB810:GOSUB609:GOSUB1300
2560 ATTRS(1)=3:CLOSE1:GOTO80
3000!    DISPLAY NUMBER OF RECORDS
3010 GOSUB302:GOSUB500:OPEN1N$:S=SIZE(1):T=FREETR(1):CLOSE1:S=S-5:D$=RIGHT$(N$+LEN(N$)-2)
3020 GOSUB302:PRINT"NUMBER OF RECORDS IN "D$" FILE":PRINT"ARE AS FOLLOWS:":PRINT
3030 PRINT"PARAMETER RECORDS";TAB(30)" 5":PRINT
3040 PRINT"DATA RECORDS";TAB(30)S:PRINT
3050 PRINT"TOTAL RECORDS USED";TAB(30)S+5:PRINT
3060 PRINT"TRACKS AVAILABLE ON DISK";TAB(30)T:GOSUB997
3070 GOSUB302:PRINT"DO YOU WISH TO DISPLAY ANOTHER FILE":GOSUB990:IFA$="Y"THENA3=0:GOTO3000
3080 D$="":GOTO80
3200!    REMOVE FILE FROM DATA BASE
3210 GOSUB400:GOSUB302:GOSUB500
3220 OPEN1N$:ATTRS(1)=0:CLOSE1:SCRATCHN$:A3=0:GOSUB302:PRINT"DO YOU WANT TO REMOVE ANOTHER FILE"
3230 GOSUB990:IFA$="Y"THEN3200
3240 GOTO80
3400!    DUPLICATE FILE PARAMETERS
3410 GOSUB302:PRINT"ENTER NAME OF MASTER FILE":INPUTN$:GOSUB520
3420 OPEN1N$ERROR3500:ATTRS(1)=3:GOSUB1100:G$(5)="":CLOSE1
3430 GOSUB607:J=1:R1=1:FORI=1TO30:GOSUB834:F$(I)=G$:NEXTI
3440 F$(6)=H$:F$(8)="":GOSUB810
3450 GOSUB302:PRINT"ENGAGE DISK FOR NEW FILE IN DRIVE 1":GOSUB997
3460 PRINT:PRINT"ENTER NAME OF NEW FILE":INPUTN$:N$="N:1:"+N$
3470 OPEN1N$:GOSUB1300:ATTRS(1)=3:CLOSE1:A3=0
3480 GOSUB302:PRINT"DO YOU WANT TO DUPLICATE MORE FILES":GOSUB990:IFA$="Y"THEN3400
3490 GOTO80
3500 GOSUB995:GOSUB612:GOSUB997:GOSUB302:GOTO3420
3510 GOSUB995:GOSUB612:GOSUB997:GOSUB302:GOTO3450
4000 GOTO80
5000 GOTO80
9000 PLOADG"DATABASE"
```

Listing 4. MAINT.

```
10!    FILE MAINTENANCE
20! BY JOEL SHAPIRO 5/79
30!    FILENAME-MAINT
40!
50!
80!
100 GOSUB302:PRINT"FILE MAINTENANCE PROGRAM":PRINT:PRINT"FUNCTIONS AVAILABLE"
110 PRINT" 1) ADD DATA TO FILE":PRINT" 2) DISPLAY DATA"
120 PRINT" 3) SEARCH, EDIT OR CODE FOR DELETION"
130 PRINT" 4) AUTO CODE FOR DELETION":PRINT" 5) DELETE DATA-RESTACK FILE"
140 PRINT" 6) OPEN":PRINT" 7) OPEN"
145 PRINT" 8) OPEN":PRINT" 9) OPEN"
150 PRINT:INPUT"SELECT PROGRAM YOU DESIRE";A:IFA<1ORA>10THEN100
200 PRINT:INPUT"SELECT PROGRAM YOU DESIRE";A:IFA<1ORA>10THEN100
210 ON A GOTO2000,1500,3000,4000,4500,5000,5500,6000,6500,9000
300!    MERLIN S/R POKE(16R690)=ASC($) OR VARIABLE
301!
302 POKE(16R6B8)=65:D=FAA:POKE(16R6B8)=41:D=FAA:RETURN
330 POKE(16R64E)=16R80:RETURN
331 POKE(16R64E)=16R00:RETURN
400!
401 GOSUB302:GOSUB9995:GOSUB996
402 PRINT:PRINT"THIS WILL DELETE DATA":PRINT"ARE YOU SURE ?":PRINT:GOSUB9961GOSUB990
403 IFA$="Y"THENRETURN
404 GOTO80
500!
502 IFA3=1THENGOSUB9995:PRINT"SAME FILE?":GOSUB998:GOSUB990:IFA$="Y"THENRETURN
510 GOSUB9951:PRINT"ENTER NAME OF FILE"
512 PRINT"OR \ TO EXIT PROGRAM"
515 GOSUB9999:INPUTN$:IFN$=B$(1)THEN100
520 FORN9=0TO1:A$=MID$(STR$(N9),2,1):OPEN1A$+":"+N$ ERROR540
530 N$=A$+":"+N$:T=FREETR(1):CLOSE1:A3=1:RETURN
540 IFERR=40RERR=7THENNEXTN9
550 GOSUB995:PRINTERR$:PRINT"STOPPED":PRINT"MAKE CORRECTION":GOSUB999:GOSUB997:GOTO500
560 GOTO510
600!
```


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```
603 GOSUB330:PRINT"ILLEGAL INPUT!  RE-ENTER":GOSUB331:RETURN
604 GOSUB330:PRINT"ALPHABETICAL CHARACTERS IN NUMERICAL ":PRINT"FIELD.  ENTER CORRECT DATA":GOSUB331:RETURN
607 GOSUB998:PRINTTAB(10)"PROCESSING DATA":GOSUB999:RETURN
608 GOSUB998:PRINTTAB(10)"SEARCHING-WAIT":GOSUB999:RETURN
610 GOSUB330:PRINT"EXCEEDED FIELD LENGTH--RE-ENTER DATA":GOSUB331:RETURN
612 CLOSE1:GOSUB330:PRINT"DISK ERROR!":PRINTERR$:GOSUB331:GOSUB997:RETURN
613 PRINT"ENTER NUMBER OF FIELD YOU WISH TO":INPUT"CHANGE OR 0 FOR NONE";A:A=INT(A):RETURN
810!   BUILD G$(1)
812 FORI=1TO30:G$(1)=G$(1)+F$(I)+Y$:NEXTI:RETURN
830!   PARSE G$(R1)
831 IFI>10THENR1=3
832 IFI>20THENR1=4
834 J=LEN(G$(R1)):X=INDEX(G$(R1),Y$):IFX=0THEN838
836 G$=LEFT$(G$(R1),X-1):G$(R1)=RIGHT$(G$(R1),J-X)
838 RETURN
840!   PARSE G$ (TITLE, FIELD, CODE)
844 X=0:Y$(I)=RIGHT$(G$,2):G$=LEFT$(G$,LEN(G$)-2)
846 X=INDEX(G$,B$(1)):X$(I)=LEFT$(G$,X-1)
848 Z$(I)=MID$(G$,X+1,LEN(G$)-X)
849 RETURN
850!   LOAD Y ARRAY WITH FIELD DATA
851 Y(1)=2:IFVAL(F$(2))<2THENRETURN
852 FORI=2TOVAL(F$(2)):Y(I)=Y(I-1)+VAL(Z$(I-1)):NEXTI:RETURN
900!   COMPOSES DATE STRING (G$(2)))
901 X=3:FORK=1TOLEN(G$(2)):A$=MID$(G$(2),K,1):IFASC(A$)<48ORASC(A$)>57THEN904
902 B$=B$+A$
903 NEXTK
904 G$(X)=B$:X=X+1:B$="":IFK<LEN(G$(2))THEN903
905 IFLEN(G$(5))>2THENG$(5)=RIGHT$(G$(5),2)
906 FORJ=3TO5:IFLEN(G$(J))<2THENG$(J)="0"+G$(J)
907 NEXTJ:G$(2)=G$(3)+B$(7)+G$(4)+B$(7)+G$(5):RETURN
924 FORI=1TO5:G$(I)="":NEXTI:RETURN
990 INPUT"( Y OR N )";A$:IFA$<>"Y"ANDA$<>"N"THEN990
991 RETURN
995 PRINTREPEAT$(CHAR$(13),25):RETURN
996 PRINTREPEAT$(CHAR$(61),39):RETURN
997 PRINT:INPUT"PRESS RETURN TO CONTINUE";A:RETURN
998 PRINTREPEAT$(CHAR$(13),9):RETURN
999 PRINTREPEAT$(CHAR$(13),7):RETURN
1000!   READS PARAMETER DATA AND SETS ARRAYS
1001 GOSUB302:GOSUB500:OPEN1N$ERROR1002:ATTRS(1)=0:GOTO1003
1002 GOSUB612:GOTO1001
1003 GOSUB1110:GOSUB302:GOSUB1030:GOSUB302:GOSUB850:RETURN
1010!   DISPLAY RECORDS 2-4 TITLE DATA
1011 L=0:FORI=1TOVAL(F$(2)):L=L+1:IFL=15THENL=0:GOSUB997
1012 IFI=1THENPRINTTAB(10)"RECORD #2"
1013 IFI=11THENPRINTTAB(10)"RECORD #3"
1014 IFI=21THENPRINTTAB(10)"RECORD #4"
1017 PRINTI;TAB(6)X$(I);TAB(25)Z$(I);TAB(31)Y$(I)
1018 NEXTI:IFL=0THENRETURN
1019 GOSUB997:RETURN
1030!   DISPLAY FILE HEADING
1032 PRINT"HEADING DATA FOR FILE - ";RIGHT$(N$,LEN(N$)-2):PRINT
1034 PRINT"CODE = ";F$(1):PRINT"NUMBER OF FIELDS = ";F$(2):PRINT"SPECIAL FILENAME = ";F$(7)
1036 PRINT"DATE CREATED = ";F$(6):PRINT"LAST UPDATE = ";F$(8):PRINT:IFG$(5)=""ORG$(5)="0"THENF$(3)="0":GOTO1038
1037 PRINT"RECORD $5 MESSAGE":PRINTG$(5)
1038 IFVAL(F$(3))>=1THENPRINTF$(3);" RECORDS CODED FOR DELETION":T1=VAL(F$(3))
1039 PRINT"DATA RECORDS IN FILE";SIZE(1)-5:PRINT"RECORDS REMAINING ON DISK ";T*16:PRINT:GOSUB997:RETURN
1050!   DISPLAY DATA (G$(1))
1052 FORI=1TOVAL(F$(2))
1054 G$(2)="":G$(2)=MID$(G$(1),Y(I),VAL(Z$(I)))
1055 PRINTI;TAB(5)X$(I);TAB(25)G$(2)
1056 IFI=15ORI=2*15THENGOSUB997
1058 NEXTI:RETURN
1060!   PULLS OUT SPECIFIC FIELD FOR SEARCH
1061 G$(2)="":G$(2)=MID$(G$(1),Y(A),VAL(Z$(A))):RETURN
1100!   READ RECORDS 1-5 FROM FILE
1101 FORI=1TO5:GET1RECORDIG$(I):NEXTI:RETURN
1110!   READ G$(1-5)FROM FILE:LOAD ARRAYS
1112 GOSUB1100:GOSUB607:R1=1:FORI=1TO30:GOSUB834:F$(I)=G$:NEXTI
1114 R1=2:FORI=1TOVAL(F$(2)):GOSUB830:GOSUB840:NEXTI
1119 RETURN
1300!   WRITE G$(1-5) TO DISK
1301 FORI=1TO5:PUT1RECORDIG$(I):NEXTI:RETURN
1500!   DISPLAY DATA
1510 GOSUB1000:G$(1)="":GETSEEK(1)=6:FORJ=RECGET(1)TOSIZE(1):GET1G$(1):IFLEFT$(G$(1),1)=B$(9)THEN1540
1520 GOSUB302:GOSUB1050:PRINT:PRINT"PRESS RETURN TO CONTINUE":INPUT"ENTER \ TO STOP";A$
1530 IFA$=B$(1)THEN1550
1540 NEXTJ
1550 ATTRS(1)=3:CLOSE1:GOSUB302:PRINT"ANY MORE FILES TO DISPLAY":GOSUB990:IFA$="Y"THEN1500
1560 GOTO80
2000!   ADD DATA TO FILE
2010 GOSUB1000:GOSUB924:GOSUB302:PRINT"ENTER DATA AS REQUESTED.  WHEN DONE":PRINT"ENTER \ FOR FIRST FIELD."
2020 PRINT"RECORD NUMBER ";RECPUT(1):G$(1)=B$(4):FORI=1TOVAL(F$(2)):G$(2)="":IFRIGHT$(Y$(I),1)<>B$(9)THEN2110
2030 PRINTI;TAB(6)X$(I);"    ";Z$(I);"  CTRS";"   CODE ";LEFT$(Y$(I),1):INPUTG$(2):IFG$(2)=B$(1)THEN2150
2040 IFLEN(G$(2))>VAL(Z$(I))THENGOSUB610:GOTO2030
```


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```
2050 IFLEFT$(X$(I),4)=B$(13)THENG$(3)="":G$(4)="":G$(5)="":GOSUB900
2060 IFLEFT$(Y$(I),1)<>B$(2)ANDLEFT$(Y$(I),1)<>B$(3)THEN2110
2070 FORK=1TOLEN(G$(2)):L=ASC(MID$(G$(2),K,1)):IFL=46ORL=45ORL=43THEN2090
2080 IFL<48ORL>57THENGOSUB604:GOTO2030
2090 NEXTK
2100 IFLEFT$(Y$(I),1)=B$(3)ANDLEN(G$(2))<VAL(Z$(I))THENG$(2)=REPEAT$(CHAR$(32),VAL(Z$(I))-LEN(G$(2)))+G$(2):GOTO2120
2110 IFLEN(G$(2))<VAL(Z$(I))THENG$(2)=G$(2)+REPEAT$(CHAR$(32),VAL(Z$(I))-LEN(G$(2)))
2120 G$(1)=G$(1)+G$(2):NEXTI
2130 GOSUB302:GOSUB1050:PRINT"IS THIS O.K.":GOSUB990:IFA$="N"THEN2020
2140 PUT1G$(1):GOSUB302:GOTO2020
2150 G$(1)="":F$(8)=H$:GOSUB810:PUT1RECORD1G$(1)
2160 ATTRS(1)=3:CLOSE1:GOTO80
3000!   SEARCH, EDIT OR CODE FOR DELETION
3010 GOSUB1000:GOSUB924:GOSUB302:PRINT"YOU CAN SEARCH BY":PRINT:PRINT" 1) RECORD NUMBER":PRINT" 2) FIELD"
3020 PRINT:INPUT"SELECT SEARCH MODE";A:A=INT(A):ONAGOTO3050,3110
3030 IFA<1ORA>2THEN3020
3040 GOTO3010
3050 GOSUB302:INPUT"RECORD NUMBER FOR SEARCH";A:IFA<6ORA>SIZE(1)THEN3050
3060 GET1RECORDAG$(1):IFLEFT$(G$(1),1)=B$(9)THENPRINT"CODED FOR DELETION":GOSUB997
3070 GOSUB302:GOSUB1050:PRINT:PRINT"IS THIS THE CORRECT ENTRY":GOSUB990:IFA$="Y"THENJ1=A:GOTO3230
3080 PRINT:PRINT"DO YOU WANT TO TRY ANOTHER RECORD #":GOSUB990:IFA$="Y"THEN3050
3090 PRINT:PRINT"DO YOU WANT TO TRY A FIELD SEARCH":GOSUB990:IFA$="Y"THEN3110
3100 CLOSE1:GOTO80
3110 GOSUB302:GOSUB1010:PRINT:INPUT"SELECT FIELD YOU WISH TO SEARCH BY";A:IFINT(A)<1ORINT(A)>VAL(F$(2))THEN3110
3120 PRINT:PRINT"ENTER FIELD DATA FOR SEARCH COMPARE":INPUTG$(2)
3130 IFLEFT$(X$(A),4)=B$(13)THENGOSUB900:GOTO3150
3135 IFLEFT$(Y$(A),1)=B$(3)ANDLEN(G$(2))<VAL(Z$(A))THENG$(2)=REPEAT$(CHAR$(32),VAL(Z$(A))-LEN(G$(2)))+G$(2):GOTO3150
3140 IFLEN(G$(2))<VAL(Z$(A))THENG$(2)=G$(2)+REPEAT$(CHAR$(32),VAL(Z$(A))-LEN(G$(2)))
3150 C$=G$(2)
3160 FORJ=6TOSIZE(1):GET1RECORDJG$(1):GOSUB1060:IFG$(2)=C$THEN3200
3170 NEXTJ
3180 GOSUB302:PRINT"ENTRY NOT FOUND. DO YOU WANT TO TRY":PRINT"ANOTHER SEARCH":GOSUB990:IFA$="Y"THEN3110
3190 CLOSE1:GOTO80
3200 IFLEFT$(G$(1),1)=B$(9)THENPRINT"CODED FOR DELETION":GOSUB997
3210 GOSUB302:GOSUB1050:PRINT"IS THIS THE CORRECT ENTRY":GOSUB990:IFA$="Y"THENJ1=J:GOTO3230
3220 GOTO3170
3230 GOSUB302:PRINT"DO YOU WANT TO";":PRINT:PRINT" 1) CODE FOR DELETION":PRINT" 2) EDIT DATA"
3240 PRINT" 3) REMOVE DELETION CODING":PRINT" 4) RETURN TO SEARCH"
3250 PRINT:INPUT"ENTER NUMBER FOR OPTION YOU WANT";A:A=INT(A):IFA<1ORA>4THEN3230
3260 ONAGOTO3270,3290,3480,3500
3270 G$=RIGHT$(G$(1),LEN(G$(1))-1):G$(1)=B$(9)+G$
3280 PUT1RECORDJ1G$(1):T1=T1+1:GOTO3420
3290 GOSUB302:GOSUB1050:INPUT"SELECT FIELD YOU WANT TO EDIT";A:A=INT(A):GOSUB1060
3300 E$=LEFT$(G$(1),Y(A)-1):F$=RIGHT$(G$(1),LEN(G$(1))+1-Y(A)-LEN(G$(2)))
3310 GOSUB302:PRINT"TITLE ";X$(A):PRINT"LENGTH ";Z$(A):PRINT"CODE ";Y$(A):PRINT"OLD DATA ";G$(2):PRINT
3320 INPUT"ENTER NEW DATA";C$:IFLEN(C$)>VAL(Z$(A))THENGOSUB610:GOTO3320
3330 IFLEFT$(Y$(A),1)<>B$(2)ANDLEFT$(Y$(A),1)<>B$(3)THEN3380
3340 FORK=1TOLEN(C$):L=ASC(MID$(C$,K,1)):IFL=46ORL=45ORL=43THEN3360
3350 IFL<48ORL>57THENGOSUB604:GOTO3320
3360 NEXTK
3370 IFLEFT$(Y$(A),1)=B$(3)ANDLEN(C$)<VAL(Z$(A))THENC$=REPEAT$(CHAR$(32),VAL(Z$(A))-LEN(C$))+C$:GOTO3390
3380 IFLEN(C$)<VAL(Z$(A))THENC$=C$+REPEAT$(CHAR$(32),VAL(Z$(A))-LEN(C$))
3390 G$(1)=E$+C$+F$:GOSUB302:GOSUB1050:PRINT"ANY MORE FIELDS TO EDIT":GOSUB990
3400 IFA$="Y"THEN3290
3410 PUT1RECORDJ1G$(1)
3420 GOSUB302:PRINT"ANY MORE RECORDS TO EDIT":GOSUB990:IFA$="Y"THEN3080
3430 IFT1>=1THENG$(5)="RECORDS CODED FOR DELETION IN FILE!"
3440 IFT1=0THENG$(5)="0"
3450 PUT1RECORD5G$(5)
3460 G$(1)="":F$(8)=H$:F$(3)=STR$(T1):GOSUB810:PUT1RECORD1G$(1)
3470 ATTRS(1)=3:CLOSE1:GOTO80
3480 G$=RIGHT$(G$(1),LEN(G$(1))-1):G$(1)=B$(4)+G$
3490 PUT1RECORDJ1G$(1):T1=T1-1:GOTO3420
3500 CLOSE1:GOTO3010
4000!   AUTO CODE FOR DELETION
4010 GOSUB1000:GOSUB924:GOSUB302:PRINT"THIS IS AN AUTOMATIC SEARCH AND CODING":PRINT"FUNCTION WHICH WILL CODE ALL ENTRIES"
4020 PRINT"BETWEEN SPECIFIED LIMITS FOR DELETION":PRINT"IN ANOTHER PORTION OF THIS PROGRAM."
4030 PRINT:PRINT"IF THE UPPER OR LOWER LIMIT IS NOT TO":PRINT"BE OBSERVED ENTER \ WHEN THAT DATA"
4040 PRINT"IS REQUESTED.":GOSUB997
4050 GOSUB302:GOSUB1010:PRINT:INPUT"SELECT FIELD YOU WISH TO SEARCH BY";A:IFINT(A)<1ORINT(A)>VAL(F$(2))THEN4050
4060 PRINT:INPUT"ENTER DATA FOR LOWER LIMIT";G$(2):IFG$(2)=B$(1)THENC$="":GOTO4100
4070 IFLEFT$(X$(A),4)=B$(13)THENGOSUB900:GOTO4090
4080 IFLEN(G$(2))<VAL(Z$(A))THENG$(2)=G$(2)+REPEAT$(CHAR$(32),VAL(Z$(A))-LEN(G$(2))):IFLEFT$(X$(A),4)=B$(13)THENGOSUB900
4090 C$=G$(2):G$(2)=""
4100 PRINT:INPUT"ENTER DATA FOR UPPER LIMIT";G$(2):IFG$(2)=B$(1)THEND$=REPEAT$(CHAR$(255),250):GOTO4140
4110 IFLEFT$(X$(A),4)=B$(13)THENGOSUB900:GOTO4130
4120 IFLEN(G$(2))<VAL(Z$(A))THENG$(2)=G$(2)+REPEAT$(CHAR$(32),VAL(Z$(A))-LEN(G$(2))):IFLEFT$(X$(A),4)=B$(13)THENGOSUB900
4130 D$=G$(2)
4140 A5=0:T1=0:IFLEFT$(X$(A),4)=B$(13)THENA5=1
4150 GOSUB607:FORJ=6TOSIZE(1):GET1RECORDJG$(1):GOSUB1060:IFA5=1THEN4180
4160 IFG$(2)>=C$ANDG$(2)<=D$THENGOSUB4300
4170 GOTO4200
4180 IFRIGHT$(G$(2),2)<=RIGHT$(C$,2)THENIFLEFT$(G$(2),2)<=LEFT$(C$,2)THENIFMID$(G$(2),4,2)<=MID$(C$,4,2)THENGOSUB4300
4190 GOTO4200
4200 NEXTJ
4210 IFT1>=1THENG$(5)="RECORDS CODED FOR DELETION IN FILE!":PUT1RECORD5G$(5)
4220 G$(1)="":F$(8)=H$:GOSUB810:PUT1RECORD1G$(1):ATTRS(1)=3:CLOSE1
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```
4230 IFC$=""THENC$=B$(1)
4240 IFLEFT$(D$,1)=CHAR$(255)THEND$=B$(1)
4250 GOSUB302:IFT1=1THENPRINTT1;"RECORD ";:GOTO4270
4260 PRINTT1;"RECORDS ";
4270 PRINT"FROM":PRINT:PRINTC$:PRINTTAB(5)"TO":PRINT:PRINTD$:PRINT:PRINT"CODED FOR DELETION.":GOSUB997
4280 GOSUB302:PRINT"MORE FILES FOR CODING":GOSUB990:IFA$="Y"THENA3=0:GOTO4000
4290 GOTO80
4300 G$(1)=RIGHT$(G$(1),LEN(G$(1))-1):G$(1)=B$(9)+G$(1):T1=T1+1
4310 PUT1RECORDJG$(1):RETURN
4500 CHAIN"DELETE"
5000 GOTO100
5500 GOTO100
6000 GOTO100
6500 GOTO100
9000 PLOAD6"DATABASE"
```

Listing 5. DELETE.

```
10!   DELETE DATA PROGRAM
20!
30!   BY JOEL SHAPIRO 5/79
40!
50!     FILENAME-DELETE
60!
80!
100 GOSUB302:PRINT"DATA DELETION PROGRAM":PRINT:PRINT"DO YOU WANT TO:"
110 PRINT:PRINT" 1) DELETE TO ANOTHER FILE":PRINT" 2) DELETE ALL CODED DATA":PRINT" 3) RETURN TO FILE MAINTENANCE PROGRAM"
120 PRINT:PRINT"SELECT FUNCTION YOU DESIRE":INPUTA:A=INT(A):IFA<1ORA>3THEN100
130 ONAGOTO2000,3000,9950
300!   MERLIN S/R POKE(16R690)=ASC(*) OR VARIABLE
301!
302 POKE(16R6BB)=65:D=FAA:POKE(16R6BB)=41:D=FAA:RETURN
330 POKE(16R64E)=16R80:RETURN
331 POKE(16R64E)=16R00:RETURN
400!
401 GOSUB302:GOSUB999:GOSUB996
402 PRINT:PRINT"THIS WILL DELETE DATA":PRINT"ARE YOU SURE ?":PRINT:GOSUB996:GOSUB990
403 IFA$="Y"THENRETURN
404 GOTO80
500!
502 IFA3=1THENGOSUB995:PRINT"SAME FILE?":GOSUB998:GOSUB990:IFA$="Y"THENRETURN
510 GOSUB995:PRINT"ENTER NAME OF FILE"
512 PRINT"OR \ TO EXIT PROGRAM"
515 GOSUB9998INPUTN$:IFN$=B$(1)THEN100
520 FORN9=0TO1:A$=MID$(STR$(N9),2,1):OPENXA$+":"+N$ ERRORS40
530 N$=A$+":"+N$:T=FREETR(1):CLOSEXTA3=1:RETURN
540 IFERR=40RERR=77THENNEXTN99550 GOSUB995:PRINTERR$:PRINT"STOPPED":PRINT"MAKE CORRECTION":GOSUB999:GOSUB997:GOTO500
560 GOTO510
612 CLOSE1:GOSUB330:PRINT"DISK ERROR!":PRINTERR$:GOSUB331:GOSUB997:RETURN
990 INPUT"( Y OR N )";A$:IFA$<>"Y"ANDA$<>"N"THEN990
991 RETURN
995 PRINTREPEAT$(CHAR$(13),25):RETURN
996 PRINTREPEAT$(CHAR$(61),39):RETURN
997 PRINT:INPUT"PRESS RETURN TO CONTINUE";A:RETURN
998 PRINTREPEAT$(CHAR$(13),9):RETURN
999 PRINTREPEAT$(CHAR$(13),7):RETURN
2000!   DELETE TO ANOTHER FILE
2010 X=1:GOSUB302:PRINT"ENTER NAME OF FILE FROM WHICH YOU":PRINT"ARE DELETING DATA":INPUTN$:GOSUB520:GOSUB400
2020 A3=0:OPEN1N$ERROR3120:GOSUB302:PRINT"ENTER NAME OF FILE TO WHICH YOU ARE":PRINT"ADDING THE DATA":INPUTN$
2030 X=2:GOSUB520:OPEN2N$ERROR2040:ATTRS(2)=0:GOTO2050
2040 GOSUB612:PRINT"CORRECT ERROR":GOSUB997:GOTO2000
2050 S1=0:T1=0:FORI=6TOSIZE(1):GET1RECORDIG$
2060 IFLEFT$(G$,1)=B$(9)THENGOSUB2080
2070 NEXTI:GOSUB302:PRINTT1;"RECORDS ADDED TO FILE ":CLOSE2:GOSUB997:GOTO3020
2080 IFS1=0THENS1=I
2090 G$=B$(4)+RIGHT$(G$,LEN(G$)-1):PUT2G$:T1=T1+1:RETURN
3000!   DELETE DATA FROM FILE
3010 S1=6:X=1:GOSUB302:GOSUB500:GOSUB400:OPEN1N$ERROR3120
3020 ATTRS(1)=0:R=0:FORI=S1TOSIZE(1):IFR=0THENJ=I
3030 GET1RECORDIG$
3040 IFLEFT$(G$,1)<>B$(9)THEN3080
3050 J=J+1:IFJ>SIZE(1)THEN3090
3060 GET1RECORDJG$:IFLEFT$(G$,1)=B$(9)THEN3050
3070 PUT1RECORDIG$:PUT1RECORDJB$(9):R=1
3080 NEXTI:I=I+1
3090 G$=""0":PUT1RECORDSG$
3100 EOF(1)=1:IFTRACKS(1)/16>SIZE(1)+16THENFREESPACE(1)
3110 ATTRS(1)=3:CLOSE1:GOSUB998:PRINT"FILE RESTACKING COMPLETE":GOSUB999:GOSUB997:GOTO80
3120 GOSUB612:PRINT"MAKE CORRECTION":GOSUB997:GOTO3000
9950 CHAIN"MAINT"
```


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Accounts Receivable	$150.00
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Tiny Pascal	45.00

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22 quality programs (req. 16K) including root of equations, integration, differentiation, simultaneous equations, matrix operations, interpolations, regression analysis (linear, polynomial, multiple), ordinary differential equations, partial differential equations, statistics and plotting; with manual.

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Solves single and simultaneous ordinary differential equations; can handle even 'stiff' problems; error control and formatted output to CRT or printer; with manual.

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Dr. Lee ✓L3

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ANNOUNCING
¿COMPUPRISM?

CHECK THIS LITTLE MUTANT OUT !!!

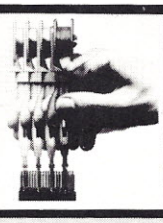
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16K on board memory!!
16 colors always available!
27648 individual picture elements!
Every element programmable in any color at any time!
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16 CHANNEL A-D, 8 CHANNEL D-A FOR S-100 BUS, BARE BOARD WITH DOCUMENTATION $25

✓J13

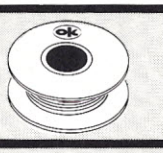
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TULSA, OK. 74101
(918) 742-7104



JUST WRAP™ WIRE WRAPPING TOOL

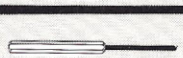
WHY CUT? WHY STRIP? WHY SLIT? WHY NOT JUST WRAP?

JW-1-B	BLUE WIRE	$14.95
JW-1-W	WHITE WIRE	$14.95
JW-1-Y	YELLOW WIRE	$14.95
JW-1-R	RED WIRE	$14.95



JUST WRAP REPLACEMENT ROLLS

R-JW-B	BLUE WIRE	50 ft. Roll	$2.98
R-JW-W	WHITE WIRE	50 ft. Roll	$2.98
R-JW-Y	YELLOW WIRE	50 ft. Roll	$2.98
R-JW-R	RED WIRE	50 ft. Roll	$2.98



UNWRAP TOOL FOR JUST WRAP

JUW-1	UNWRAPPING TOOL	$3.49



JUST WRAP KIT

JWK-6	JUST WRAP KIT	$24.95



"HOBBY" WIRE WRAPPING TOOL BATTERY POWERED

BW-2630	FOR AWG 26-30	$19.95

Use "C" size NICAD Batteries, not included. Bits not included.

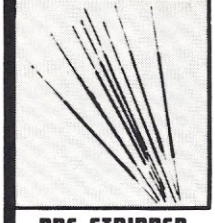
BT-30	BIT FOR AWG 30	$3.95
BT-2628	BIT FOR AWG 26-28	$7.95



HOBBY WRAP TOOLS



WSU-30	REGULAR WRAP	$6.95
WSU-30M	MODIFIED WRAP	$7.95

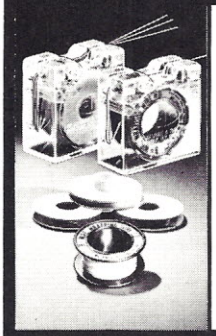


PRE-STRIPPED WIRE WRAPPING WIRE

Wire for wire-wrapping, AWG-30 (0.25mm) KYNAR® wire, 50 wires per package stripped 1" both ends.

® KYNAR-PENNWALT

30-B-50-010	30-AWG blue Wire, 1" Long	$.99
30-Y-50-010	30-AWG Yellow Wire, 1" Long	$.99
30-W-50-010	30-AWG White Wire, 1" Long	$.99
30-R-50-010	30-AWG Red Wire, 1" Long	$.99
30-B-50-020	30-AWG Blue Wire, 2" Long	$1.07
30-Y-50-020	30-AWG Yellow Wire, 2" Long	$1.07
30-W-50-020	30-AWG White Wire, 2" Long	$1.07
30-R-50-020	30-AWG Red Wire, 2" Long	$1.07
30-B-50-030	30-AWG Blue Wire, 3" Long	$1.16
30-Y-50-030	30-AWG Yellow Wire, 3" Long	$1.16
30-W-50-030	30-AWG White Wire, 3" Long	$1.16
30-R-50-030	30-AWG Red Wire, 3" Long	$1.16
30-B-50-040	30-AWG Blue Wire, 4" Long	$1.23
30-Y-50-040	30-AWG Yellow Wire, 4" Long	$1.23
30-W-50-040	30-AWG White Wire, 4" Long	$1.23
30-R-50-040	30-AWG Red Wire, 4" Long	$1.23
30-B-50-050	30-AWG Blue Wire, 5" Long	$1.30
30-Y-50-050	30-AWG Yellow Wire, 5" Long	$1.30
30-W-50-050	30-AWG White Wire, 5" Long	$1.30
30-R-50-050	30-AWG Red Wire, 5" Long	$1.30
30-B-50-060	30-AWG Blue Wire, 6" Long	$1.38
30-Y-50-060	30-AWG Yellow Wire, 6" Long	$1.38
30-W-50-060	30-AWG White Wire, 6" Long	$1.38
30-R-50-060	30-AWG Red Wire, 6" Long	$1.38



TRI-COLOR DISPENSER

WD-30-TRI	TRI-COLOR DISPENSER	$5.95
R-30-TRI	REPLACEMENT ROLLS	$3.95

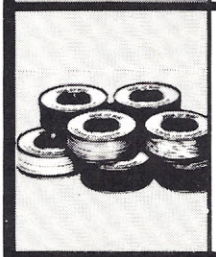
WIRE DISPENSER

WD-30-B	BLUE WIRE	$3.95
WD-30-Y	YELLOW WIRE	$3.95
WD-30-W	WHITE WIRE	$3.95
WD-30-R	RED WIRE	$3.95

DISPENSER REPLACEMENT ROLLS

R-30B-0050	30-AWG BLUE 50 FT. ROLL	$1.98
R-30Y-0050	30-AWG YELLOW 50 FT. ROLL	$1.98
R-30W-0050	30-AWG WHITE 50 FT. ROLL	$1.98
R-30R-0050	30-AWG RED 50 FT. ROLL	$1.98

®KYNAR-PENNWALT



HOOK-UP WIRE

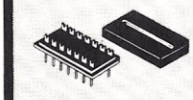
HK-18	18 AWG	25 FT.	SOLID CONDUCTOR	$1.20
HK-20	20 AWG	25 FT.	SOLID CONDUCTOR	$ .98
HK-22	22 AWG	50 FT.	SOLID CONDUCTOR	$1.35
HK-24	24 AWG	50 FT.	SOLID CONDUCTOR	$1.35
HK-26	26 AWG	50 FT.	SOLID CONDUCTOR	$1.35
SHK-18	18 AWG	25 FT.	STRANDED CONDUCTOR	$1.20
SHK-20	20 AWG	25 FT	STRANDED CONDUCTOR	$ .98
SHK-22	22 AWG	50 FT.	STRANDED CONDUCTOR	$1.35
SHK-24	24 AWG	50 FT.	STRANDED CONDUCTOR	$1.35
SHK-26	26 AWG	50 FT.	STRANDED CONDUCTOR	$1.35



RIBBON CABLE ASSEMBLY SINGLE END

26 AWG Rainbow Coded flat cable.

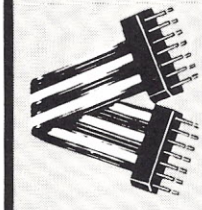
SE 14-24	WITH 14 PIN DIP PLUG 24" LONG (609MM)	$3.55
SE 14-48	WITH 14 PIN DIP PLUG 48" LONG (1218MM)	$4.25
SE 16-24	WITH 16 PIN LONG DIP PLUG 24" LONG (609MM)	$3.75
SE 16-48	WITH 16 PIN LONG DIP PLUG 48" LONG (1218MM)	$4.45



DIP PLUG WITH COVER FOR USE WITH RIBBON CABLE

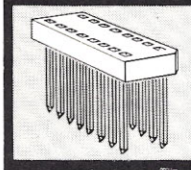
14-PLG	14 PIN PLUG & COVER	$1.45
16-PLG	16 PIN PLUG & COVER	$1.59

QUANTITY: 2 PLUGS, 2 COVERS



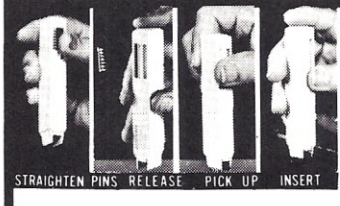
RIBBON CABLE ASSEMBLY DOUBLE END

DE 14-2	WITH 14 PIN DIP PLUG – 2"	$3.75
DE 14-4	WITH 14 PIN DIP PLUG – 4"	$3.85
DE 14-8	WITH 14 PIN DIP PLUG – 8"	$3.95
DE 14-12	WITH 14 PIN DIP PLUG – 12"	$4.07
DE 14-16	WITH 14 PIN DIP PLUG – 16"	$4.12
DE 14-24	WITH 14 PIN DIP PLUG – 24"	$4.15
DE 16-2	WITH 16 PIN DIP PLUG – 2"	$4.15
DE 16-4	WITH 16 PIN DIP PLUG – 4"	$4.25
DE 16-8	WITH 16 PIN DIP PLUG – 8"	$4.35
DE 16-12	WITH 16 PIN DIP PLUG – 12"	$4.47
DE 16-16	WITH 16 PIN DIP PLUG – 16"	$4.52
DE 16-24	WITH 16 PIN DIP PLUG – 24"	$4.55
DE 24-6	WITH 24 PIN DIP PLUG – 6"	$6.05
DE 24-8	WITH 24 PIN DIP PLUG – 8"	$6.50
DE 24-12	WITH 24 PIN DIP PLUG – 12"	$6.90
DE 24-16	WITH 24 PIN DIP PLUG – 16"	$7.10
DE 24-24	WITH 24 PIN DIP PLUG – 24"	$7.70



DIP SOCKETS

14 DIP	14 PIN DIP SOCKET	$0.79
16 DIP	16 PIN DIP SOCKET	$0.89
24 DIP	24 PIN DIP SOCKET	$1.49
36 DIP	36 PIN DIP SOCKET	$2.49
40 DIP	40 PIN DIP SOCKET	$2.99



DIP IC INSERTION TOOLS WITH PIN STRAIGHTNER

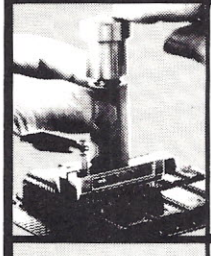
Narrow profile. Pin straightener built into tool. Automatic ejector.

INS-1416	14-16 PIN DIP/IC INSERTER	$3.49

MOS, CMOS-SAFE

GROUND STRAP NOT INCLUDED

MOS-1416	14-16 PIN, MOS CMOS SAFE INSERTER	$7.95
MOS-2428	24-28 PIN, MOS CMOS SAFE INSERTER	$7.95

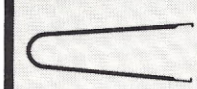


36-40 PIN CMOS-SAFE IC INSERTION TOOL

Aligns bent out pins. Includes terminal lug for attachment of ground strap.

GROUND STRAP NOT INCLUDED

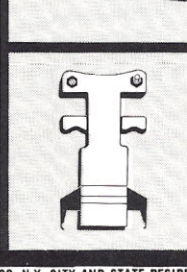
MOS-40	36-40 PIN CMOS SAFE INSERTION TOOL	$7.95



DIP IC EXTRACTOR TOOL

Extracts all LSI, MSI and SSI devices of from 8 to 24 pins.

EX-1	EXTRACTOR TOOL	$1.49



24-40 CMOS-SAFE EXTRACTOR TOOL

Removes 24-40 pin IC's, .600" centers. C-MOS safe. Includes terminal lug for attachment of ground strap.

GROUND STRAP NOT INCLUDED

EX-2	CMOS SAFE EXTRACTOR TOOL	$7.95

MINIMUM ORDER $25.00, SHIPPING CHARGE $2.00, N.Y. CITY AND STATE RESIDENTS ADD TAX

OK MACHINE & TOOL CORPORATION

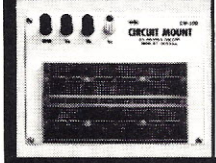
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PRB-1 DIGITAL LOGIC PROBE

- DC to > 50 MHZ
- 10 Nsec. pulse response
- 120 K Ω impedance
- Automatic pulse stretching to 50 Msec.
- Automatic resetting memory
- Open circuit detection
- Automatic threshold resetting
- Compatible with all logic families 4-15 VDC
- Range extended to 15-25 VDC with optional PA-1 adapter
- Supply O.V.P. to ± 70 VDC
- No switches/no calibration

PRB-1	DIGITAL LOGIC PROBE	$36.95

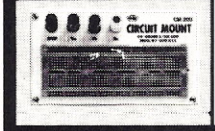


PROTOTYPE BOARD CM-100

TERMINALS: 1,020 TEST POINTS. 188 separate 5 point terminals, plus 2 horizontal bus lines of 40 common test points each.

SIZE: 6½" Wide, 5" Long.

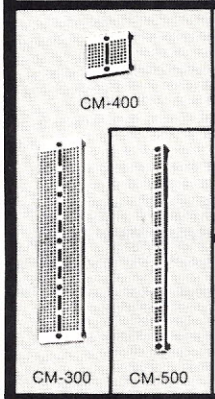
CM-100	MODULAR PROTOTYPE BOARD	$25.95



PROTOTYPE BOARD CM-200

TERMINALS: 630 TEST POINTS. 94 separate 5 point terminals, plus 4 bus lines of 40 common test points each. SIZE: 6" Wide, 3½" Long.

CM-200	MODULAR PROTOTYPE BOARD	$16.45



PROTOTYPE BOARD CM-300, CM-400

CM-300 and CM-400 have two separated rows of five interconnected contacts each. Each pin of a DIP inserted in the strip will have four additional tie-points per pin to insert connecting wires. They accept leads and components up to .032 in. diameter. Interconnections are readily made with RW-50 Jumper Wire. All contact sockets are on a .100 in. square grid (1⅜ in. wide).

CM-300	MODULAR PROTOTYPE BOARD	$9.95
CM-400	MODULAR PROTOTYPE BOARD	$2.45

MODULAR BUS STRIP

CM-500 is a bus strip to be used in conjunction with CM-300 and CM-400 for distribution of power and common signed lines. Two separate rows of common terminals, grouped into clusters of five. All contact sockets are on a .100 in. square grid.

CM-500	MODULAR BUS STRIP	$1.95



JUMPER WIRES

50 Preformed wires, from 1½ to 4 inches, 20 AWG solid wire, white insulation.

RW-50	JUMPER WIRES	$2.98

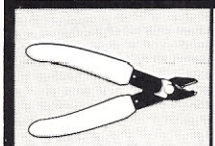


"CLIP AND STRIP" TOOL

For cutting and stripping 1 in. insulation from 30 AWG wire.

CAS-130	CLIP AND STRIP	$1.98

THE ABOVE CUT AND STRIP TOOL IS NOT APPLICABLE FOR MYLENE OR TEFLON INSULATION



MINI SHEAR

MS-10	MINI-SHEAR	$4.95

MINI SHEAR WITH SAFETY CLIP

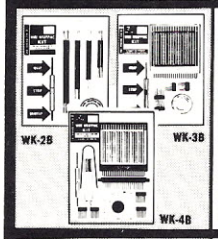
MS-20	MINI-SHEAR WITH CLIP	$5.95



VACUUM VISE

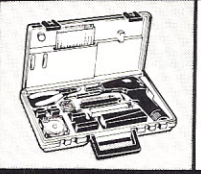
ABS construction, 1½ in. wide jaws.

V V-1	VACUUM VISE	$3.49



WIRE WRAPPING KITS WK-2, WK-3, WK-4

WK-2-B	WIRE-WRAPPING KIT (BLUE)	$12.95
WK-2-Y	WIRE-WRAPPING KIT(YELLOW)	$12.95
WK-2-W	WIRE-WRAPPING KIT (WHITE)	$12.95
WK-2-R	WIRE-WRAPPING KIT (RED)	$12.95
WK-3B (BLUE)	WIRE-WRAPPING KIT	$16.95
WK-4B (BLUE)	WIRE-WRAPPING KIT	$25.99



WIRE WRAPPING KIT WK-5

BW-630, WSU-30M, CON-1, EX-1, INS-1416, TRS-2, MS-20, 14, 16, 24 and 40 DIP sockets, WWT-1, WD-30-TR1, H-PCB-1.

WK-5	WIRE-WRAPPING KIT	$74.95



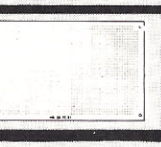
PC BOARD

4 x 4.5 x 1/16 in. board, glass coated EPOXY laminate, solder coated 1 oz. copper pads. The board has provision for a 22/44 two sided edge connector. .156 in. spacing. Edge contacts are non-dedicated for maximum flexibility.

The board contains a matrix of .040 in. diameter holes on .100 in. centers. Component side contains 76 two-hole pads.

Two independent bus systems are provided for voltage and ground on both sides of the board.

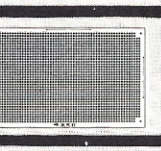
H-PCB-1	HOBBY BOARD	$4.99



TERMINAL BOARD

.062 thick glass coated epoxy laminate. Outside dimensions 6.3 in. x 3.94 in. Not plated.

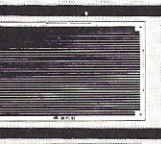
A-PC-01	TERMINAL BOARD	$3.45



PC BOARD

Same specifications as A-PC-01 except matrix pattern is copper plated and solder coated on one side.

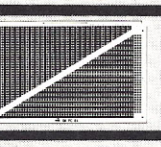
A-PC-02	PRINTED CIRCUIT BOARD	$5.95



PC BOARD

Same specifications as A-PC-01. Each line of holes is connected with copper plated and solder coated parallel strips on one side.

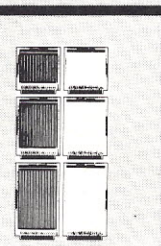
A-PC-03	PRINTED CIRCUIT BOARD	$5.95



PC BOARD

Same specifications as A-PC-01. One side has horizontal copper strips, solder coated. Second side has vertical parallel bars.

A-PC-04	PRINTED CIRCUIT BOARD	$7.95



PC BOARD

The A-PC-05 features numbered contacts for easy reference along with a numbered matrix for easy hole locations. Made of .062 in. thick epoxy laminate. 4.5 in. x 5 in. Edge Connector Board.

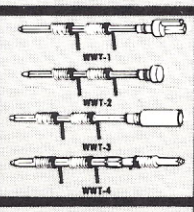
A-PC-05	PRINTED CIRCUIT BOARD	$5.45

Same as A-PC-05 except outside dimensions are 4.5 in. x 6.5 in. Edge Connector Board.

A-PC-06	PRINTED CIRCUIT BOARD	$6.95

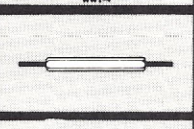
Same as A-PC-05 except outside dimensions are 4.5 in. x 7 in. Edge Connector Board.

A-PC-07	PRINTED CIRCUIT BOARD	$8.95



TERMINALS

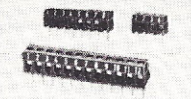
WWT-1	SLOTTED TERMINAL	$4.98
WWT-2	SINGLE SIDED TERMINAL	$2.98
WWT-3	IC SOCKET TERMINAL	$4.98
WWT-4	DOUBLE SIDED TERMINAL	$1.98



TERMINAL INSERTING TOOL

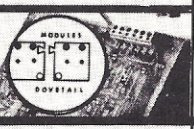
For inserting WWT-1, -2, -3 and -4 terminals.

INS-1	INSERTING TOOL	$2.49



P.C.B. TERMINAL STRIPS

TS- 4	4-POLE	$1.39
TS- 8	8-POLE	$2.19
TS-12	12-POLE	$2.99



MODULAR TERMINAL STRIPS

TS-6MD	2-POLE	$1.79

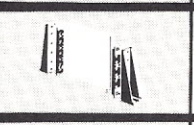
(3 per Package)



PC CARD GUIDES

TR-1	CARD GUIDES	$1.89

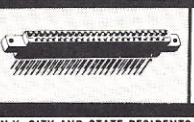
QUANTITY — ONE PAIR (2 PCS.)



PC CARD GUIDES & BRACKETS

TRS-2	GUIDES & BRACKETS	$3.79

QUANTITY — ONE SET (4 PCS.)



PC EDGE CONNECTOR

44 pin, dual read-out, .156 in. spacing, wire-wrapping.

CON-1	P.C. EDGE CONNECTOR	$3.49

MINIMUM ORDER $25.00, SHIPPING CHARGE $2.00, N.Y. CITY AND STATE RESIDENTS ADD TAX

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Dial-up Directory

"Dial-up Directory" is developing into an ongoing series. Here's installment number two.

Frank J. Derfler, Jr.
PO Box 17283
Montgomery AL 36117

Have you tried dialing up yet? If you don't have a telecommunications capability for your computer, you are missing a large part of what your system can provide. You don't really have to have a computer to participate in the computer bulletin board services (CBBS) or in personal data phone calls. A Teletype or video terminal will do, but having a computer serve as a "smart terminal" gives you the capability to save information and to exchange "RUNing" programs.

Review the CBBS list we have provided. Find a number that interests you and give it a call. Let us know

Dial-up Directory.

The following list provides the location, phone number and other information about Computer Bulletin Board Systems, Apple Bulletin Board Systems and TRS-80 Forums around the country. The differences between these systems, which are open to all, are small. Unless otherwise shown, all systems operate 24 hours a day. Hit at least three carriage returns to set the speed. I have personally checked into all of these systems. That is my only guarantee. These were verified from my list of over 80 "reported" systems.

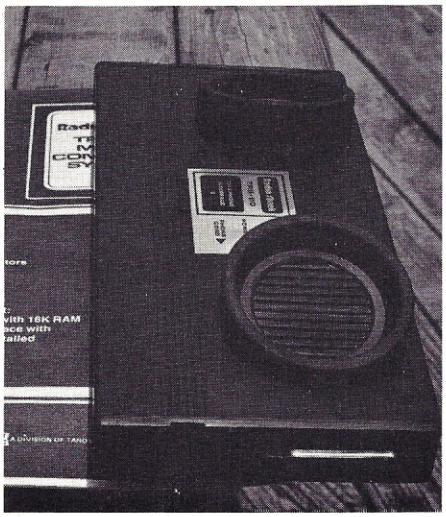
LOCATION	PHONE NO.	COMMENTS
California		
Canoga Park ABBS	213-340-0135	Apple System, well used and very friendly.
W. Palm Beach ABBS	305-689-3234	
San Diego Bill Blue's ABBS (People's Computer Sys.)	714-449-5689	SUPER system. Can transfer programs. Many features.
San Diego ABBS	714-582-9557	Service of the "Computer Merchant."
San Fernando	213-340-0135	ABBS.
San Francisco ABBS	415-948-1474	Service of the PC net.
San Francisco	415-348-2139	Forum-80.
District of Columbia		
Washington DC AMRAD	202-281-2125	Unique system links CBBS to amateur radio.
Florida		
Ft. Lauderdale	305-566-0805	ABBS.
Hollywood	305-989-9647	Many SOURCE users. (ABBS)
Miami	305-821-7401	ABBS.
Tampa	813-223-7688	Forum-80.
Georgia		
Atlanta	404-939-1520	Remote North Star. Programs to run.
Atlanta	404-394-4220	CBBS.

what your interests and capabilities are, and we will include you in the Dial-up Directory.

Modem Bargain

I have moaned several times about how expensive commercially made modems are. I don't know whether to give the credit to Radio Shack or to Novation, but between the two of them, they are now selling a high-quality commercial modem at a reasonable price.

The Radio Shack Telephone Interface II (catalog number 26-1171) is a compact, acoustically coupled modem with switch-selected originate or receive capability. It lists for $199. The version carrying the original manufacturers label (Novation) is available for $179. The modem needs a cable with a male DB-25P connector on the end to connect to the computer; otherwise, it comes ready to operate.



The Radio Shack Telephone Interface II is a compact, professional unit at a hobby price.

The Telephone Interface II has only two switches: the power switch selects the originate or answer mode, and the second switch selects between full and half duplex and a "test" mode. The test mode is useful not only for testing the modem, but also for testing computer telecommunications hardware and software. When the switch is in the test mode, the audio transmit frequencies are the same as the receive frequencies.

If you put a telephone on the coupler, the input and output will be looped back via the "sidetone" in the phone, and the modem and computer can hear themselves. You won't know how useful this is until you have stretched the patience of every other modem owner in town very thin with calls to see if you "got it right this time."

The modem comes with a comprehensive manual that is about one step above Radio Shack's usual offering. The manual contains operating instructions, pin connections and technical descriptions, a schematic and a useful system troubleshooting guide. The Telephone Interface II is a high-quality product at a more reasonable price than most.

CBBS Spotlight

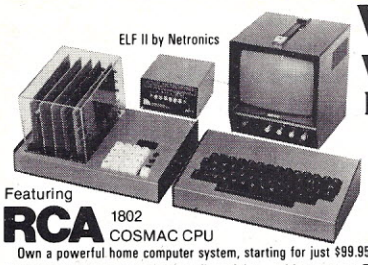
Let's consider a CBBS system, the REMOTE NORTHSTAR, operated by Les Freed and Bob Strong in Atlanta GA. This system is convenient for beginners since it doesn't get extremely heavy use, but it has many features and good prompts for new users. Users more familiar with CBBS operations will benefit from the "X," or expert, mode, which bypasses detailed instructions and saves time on long-distance phone calls.

REMOTE NORTHSTAR is primarily a message system. It usually has about 40 messages up at any one time (some of the older systems may have nearly ten times that number). The "S" command is used to call up a summary of some or all of the messages on file. Also available is a "Q" command, which sends a quick (subject only) summary. Message entry is simple. Passwords for erasure are optional, and no special codes are needed to transfer the message to disk.

A special feature of this system is a menu of utility and game programs that Les and Bob keep available for users. Nineteen programs were available the last time I looked. This is a luxury in terms of software, user demand and disk space, but it is nice to have.

A major function of REMOTE NORTHSTAR is to demonstrate the

Illinois		
Chicago CBBS	312-528-7141 (Very busy)	The "grandfather" of all. Brainchild of Ward Christensen and Randy Suess.
Chicago	312-767-0202	Forum-80.
Massachusetts		
Boston CBBS	617-963-8310	Busy and interesting system. Large message file.
Cambridge	617-864-3819	CBBS.
Michigan		
Detroit	313-288-0335	CBBS.
Missouri		
Kansas City Forum-80	816-861-7040	Very active system. Many interesting users.
New Jersey		
Bound Brook S.J. Electronic Mail	201-457-0893	Use access code HEL-I999,MAIL. A different kind of system.
Princeton	201-874-6833	Forum-80.
Ohio		
Akron	216-745-7855	ABBS.
Oregon		
Beaverton	503-646-5510	Friendly system.
South Carolina		
Columbia	803-771-0922	Remote programs to run. May not be 24 hour.
Tennessee		
Memphis	901-276-8196	Forum-80.
Texas		
Dallas CBBS	214-641-8759	Another busy system.
Ft. Worth	817-923-0009	Forum-80.
Wichita Falls	817-855-3916	Forum-80.
Virginia		
Fairfax Family History Forum	703-978-7561	Special interest group dealing with genealogy.


ELF II by Netronics

Write and run programs–the very first night–even if you've never used a computer before!

You're up and running with video graphics for just $99.95 — then use low cost add-ons to create your own personal system that rivals home computers sold for 5-times ELF II's low price!

Featuring **RCA** 1802 COSMAC CPU

Own a powerful home computer system, starting for just $99.95–a price that gets you up and running the very first night...with your own TV for a video display. $99.95 ELF II includes RCA 1802 8-bit microprocessor addressable to 64k bytes with DMA, interrupt, 16 registers, ALU, 256 byte RAM, full hex keyboard, two digit hex output display, stable crystal clock for timing purposes, RCA 1861 video IC to display your programs on any video monitor or TV screen *and 5-slot plug-in expansion bus (less connectors) to expand ELF II into a giant!*

ELF II Explodes Into A Giant!

Master ELF II's $99.95 capabilities, then expand with GIANT BOARD ... KLUGE BOARD...4k RAM BOARDS...TINY BASIC...ASCII KEYBOARD... LIGHT PEN...ELF-BUG MONITOR....COLOR GRAPHICS & MUSIC SYSTEM... TEXT EDITOR...ASSEMBLER...DISASSEMBLER...VIDEO DISPLAY BOARD ...*and*, another great reason for getting your ELF now–

BREAKTHROUGH!

Netronics proudly announced the release of the first 1802 FULL BASIC, written by L. Sandlin, with a hardware floating point RPN math package (requires 8k RAM plus ASCII and video display boards), $79.95 plus $2 p&h. Also available for RCA VIP and other 1802 systems (send for details)!

Master This Computer In A Flash!

Regardless of how minimal your computer background is now, you can learn to program an ELF II in almost no time at all. Our *Short Course On Microprocessor & Computer Programming*–written in non-technical language–guides you through each of the RCA COSMAC 1802's capabilities, so you'll understand *everything* ELF II can do...*and how to get ELF II to do it!* Don't worry if you've been stumped by computer books before. The *Short Course* represents a major advance in literary clarity in the computer field. You don't have to be a computer engineer in order to understand it. Keyed to ELF II, it's loaded with "hands on" illustrations. When you're finished with the *Short Course*, neither ELF II nor the RCA 1802 will hold any mysteries for you.

In fact, not only will you now be able to use a personal computer creatively, you'll also be able to read magazines such as BYTE...INTERFACE AGE...POPULAR ELECTRONICS and PERSONAL COMPUTING and fully *understand* the articles. And, you'll understand how to expand ELF II to give you the exact capabilities you need!

If you work with large computers, ELF II and the *Short Course* will help you understand what they're doing.

Get Started For Just $99.95, Complete!

$99.95 ELF II includes all the hardware and software you need to start writing and running programs at home, displaying video graphics on your TV screen and designing circuits using a microprocessor–the very first night–even if you've never used a computer before.

ELF II connects directly to the video input of your TV set, without any additional hardware. Or, with an $8.95 RF modulator (see coupon below), you can connect ELF II to your TV's antenna terminals instead.

ELF II has been designed to play all the video games you want, including a fascinating new target/missile gun game that was developed specifically for ELF II. But games are only the icing on the cake. The real value of ELF II is that it gives you a chance to write machine language programs–and machine language is the fundamental language of all computers. Of course, machine language is only a starting point. You can also program ELF II with assembly language and tiny BASIC. But ELF II's machine language capability gives you a chance to develop a working knowledge of computers that you can't get from running only pre-recorded tape cassettes.

ELF II Gives You The Power To Make Things Happen!

Expanded, ELF II can give you more power to make things happen in the real world than heavily advertised home computers that sell for a lot more money. Thanks to an ongoing committment to develop the RCA 1802 for home computer use, the ELF II products–being introduced by Netronics–keep you right on the outer fringe of today's small computer technology. It's a perfect computer for engineering, business, industrial, scientific and personal applications.

Plug in the **GIANT BOARD** to record and play back programs, edit and debug programs, communicate with remote devices and make things happen in the outside world. Add **Kluge** (prototyping) **Board** and you can use ELF II to solve special problems such as operating a complex alarm system or controlling a printing press. Add **4k RAM Boards** to write longer programs, store more information and solve more sophisticated problems.

ELF II add-ons already include the **ELF II Light Pen** and the amazing **ELF-BUG Monitor**–two extremely recent breakthroughs that have not yet been duplicated by any other manufacturer.

The ELF-BUG Monitor lets you debug programs with lightening speed because the key to debugging is to know what's inside the registers of the microprocessor. And, with the ELF-BUG Monitor, instead of single stepping through your programs, you can now display the entire contents of the registers on your TV screen. You find out immediately what's going on and can make any necessary changes.

The incredible ELF II Light Pen lets you write or draw anything you want on a TV screen with just a wave of the "magic wand." Netronics has also introduced the ELF II Color Graphics & Music System–more breakthroughs that ELF II owners were the first to enjoy!

ELF II Tiny BASIC

Ultimately, ELF II understands only machine language–the fundamental coding required by all computers. But, to simplify your relationship with ELF II, we've introduced an **ELF II Tiny BASIC** that makes communicating with ELF II a breeze.

Now Available! Text Editor, Assembler, Disassembler And A New Video Display Board!

The Text Editor gives you word processing ability and the ability to edit programs or text while it is displayed on your video monitor. Lines and characters may be quickly inserted, deleted or changed. Add a printer and ELF II can type letters for you–error free–plus print names and addresses from your mailing list!

ELF II's **Assembler** translates assembly language programs into hexidecimal machine code for ELF II use. The Assembler features mnemonic abbreviations rather than numerics so that the instructions on your programs are easier to read–this is a big help in catching errors.

ELF II's **Disassembler** takes machine code programs and produces assembly language source listings. This helps you understand the programs you are working with...and improve them when required.

The new **ELF II Video Display Board** lets you generate a sharp, professional 32 or 64 character by 16 line upper and lower case display on your TV screen or video monitor–dramatically improving your unexpanded $99.95 ELF II. When you get into longer programs, the Video Display Board is a real blessing!

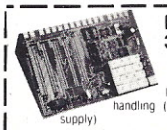
Now Available!

☐ **A-D/D-A Board Kit** includes 1 channel (expandable to 4) D-A, A-D converters, **$39.95** plus $2 postage & handling..

☐ **PILOT Language**—A *new* **text-oriented** language that allows you to write educational programs on ELF II with speed and ease! Write programs for games...unscrambling sentences...spelling drills..."fill in the missing word" tests, etc.! PILOT is a must for any ELF II owner with children. *PILOT Language on cassette tape, only $19.95 postpaid!*

☐ **Game Package** on cassette tape (requires 4k RAM), **$9.95** plus $2 postage & handling.

Clip Here and Attach to Your Order Below!



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333 Litchfield Road, New Milford, CT 06776

PHONE ORDERS ACCEPTED! Call (203) 354-9375

Yes! I want my own computer! Please rush me—

☐ RCA COSMAC ELF II kit at $99.95 plus $3 postage and handling (requires 6.3 to 8 volt AC power supply)

☐ Power Supply (required). $4.95 postpaid

☐ RCA 1802 User's Manual. $5 postpaid

☐ Tom Pittman's **Short Course On Microprocessor & Computer Programming** teaches you just about everything there is to know about ELF II or any RCA 1802 computer. Written in non-technical language, it's a learning breakthrough for engineers and laymen alike. $5 postpaid

☐ Deluxe Metal Cabinet with plexiglas dust cover for ELF II. $29.95 plus $2.50 p&h.

☐ I am also enclosing payment (including postage & handling) for the items checked below!

☐ **I want my ELF II wired and tested with power supply, RCA 1802 User's Manual and Short Course—all for just $149.95 plus $3 p&h.**

Total Enclosed $ _____
(Conn. res. add tax)

CHARGE IT! Exp. Date _____
☐ Visa ☐ Master Charge
(Bank # _____)

Account # _____

ALSO AVAILABLE FOR ELF II

☐ **GIANT BOARD™** kit with cassette I/O, RS 232-C/TTY I/O, 8-bit P I/O, decoders for 14 separate I/O instructions and a system monitor/editor **$39.95** plus $2 p&h

☐ **Kluge** (Prototype) **Board** accepts up to 36 IC's. **$17.00** plus $1 p&h

☐ **4k Static RAM kit.** Addressable to any 4k page to 64k **$89.95** plus $3 p&h

☐ Gold plated **86-pin connectors** (one required for each plug-in board) **$5.70** ea., postpaid

☐ **Expansion Power Supply** (required when adding 4k RAM) **$34.95** plus $2 p&h

☐ **Professional ASCII Keyboard** kit with 128 ASCII upper/lower case set, 96 printable characters, onboard regulator, parity, logic selection and choice of 4 handshaking signals to mate with almost any computer. **$64.95** plus $2 p&h

☐ **Deluxe metal cabinet for ASCII Keyboard. $19.95** plus $2.50 p&h

☐ **Video Display Board** kit lets you generate a sharp, professional 32 or 64 character by 16 line upper and lower case display on your tv screen or video monitor—dramatically improving your unexpanded $99.95 ELF II. (Fits inside ASCII Keyboard cabinet.) **$89.95** plus $2 p&h

☐ **ELF II Tiny BASIC** on cassette tape. Commands include SAVE, LOAD, ±, ×, ÷, (), 26 variables A-Z, LET, IF/THEN, INPUT, PRINT, GO TO, GO SUB, RETURN, END, REM, CLEAR, LIST, RUN, PLOT, PEEK, POKE. Comes fully documented and includes alphanumeric generator required to display alphanumeric characters directly on your tv screen without additional hardware. Also plays tick-tack-toe plus a drawing game that uses ELF II's hex keyboard as a joystick. 4k memory required **$14.95** postpaid

☐ Tom Pittman's **Short Course on Tiny Basic** for ELF II. **$5** postpaid

☐ **ELF-BUG™ Deluxe System Monitor** on cassette tape. Allows displaying the contents of all registers on your tv at any point in your program. Also displays 24 bytes of memory with full addresses, blinking cursor and auto scrolling. A must for the serious programmer! **$14.95** postpaid

☐ **Text Editor** on cassette tape gives you the ability to insert, delete or edit lines and words from your programs while they are displayed on your video monitor. (Add printer and you can use ELF II to type error-free letters plus insert names and addresses from your mailing list.) **$19.95** postpaid

☐ **Assembler** on cassette tape translates assembly language programs into hexidecimal machine code for ELF II use. Mnemonic abbreviations for instructions (rather than numerics) make programs easier to read and help prevent errors. **$19.95** postpaid.

☐ **Disassembler** on cassette tape takes machine code programs and produces assembly language source listings to help you understand and improve your programs. **$19.95** on cassette tape.

SAVE $9.90—Text Editor, Assembler & Disassembler purchased together, only **$49.95!** (Require Video Display Board plus 4k memory.)

☐ **ELF II Light Pen**, assembled & tested. **$7.95** plus $1 p&h

☐ **ELF II Color Graphics & Music System Board** kit. **$49.95** plus $2 p&h

☐ ELF II connects directly to the video input of your tv set without additional hardware. To connect ELF II to your antenna terminals instead, order **RF Modulator**, **$8.95** postpaid.

Coming Soon: A-D, D-A Converter, Controller Board and more!

Print Name _____

Address _____

City _____

State _____ Zip _____

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DEALER INQUIRIES INVITED

software for computer telecommunications that Les and Bob have developed. They are marketing both the CBBS package and a terminal program written in 8080 assembly language for North Star and Micropolis systems.

The personality projected by the system users is low key. This technically oriented group provides a lot of comment on available hardware and software, some chess playing and general CBBS news. This is in contrast to some of the high-spirited exchanges you may find on other systems.

When you leave this system, you can use a "G" to put a message on the local printer. Your comments to Les and Bob are welcome.

TELENET

TELENET is a national commercial packet-switched transmission system for data communications. It can presently support 56 kilobaud service. TELENET recently announced a special rate for noncommercial after-hours individual users that is potentially exciting. This after-hours service is available for only 75 cents an hour for the first 2000 packets. A packet is 128 characters, or one carriage return. Additional packets are inexpensive.

While individuals may use TELENET to talk together, I believe the most practical use is for local or regional CBBS operators to exchange selected messages between systems. Messages addressed to "ALL" with more than a local or system-wide interest can be placed on file with all CBBS's simultaneously. Speeds of 600 baud or better (depending on modems and local lines) make this a quick exchange that can probably be done automatically. The classification of the CBBS as "individual" (as opposed to "mainframes," who must pay lots more) could be troublesome. Let's hear more on your ideas or experiences with TELENET.

Listings

If you run a CBBS or want to exchange data calls on any subject, send me information about your operation. Please include the time you are available and your system capabilities, and don't forget to include your phone number. Correspondence to: Frank J. Derfler, Jr., PO Box 17283, Montgomery AL 36117, or leave a message on the Atlanta CBBS: (404) 939-1520. ■

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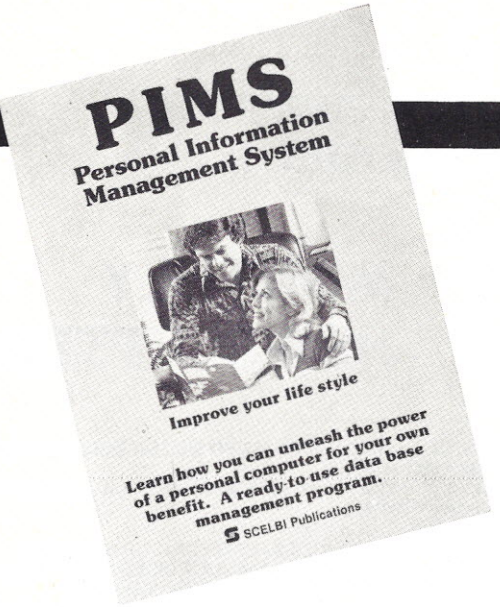
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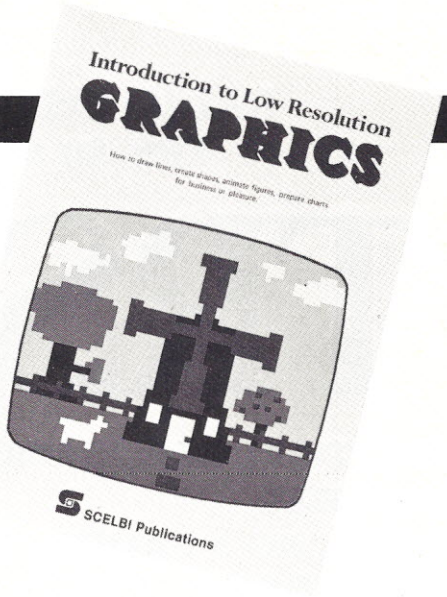
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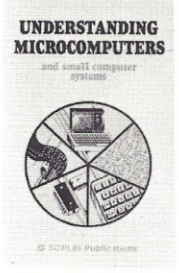
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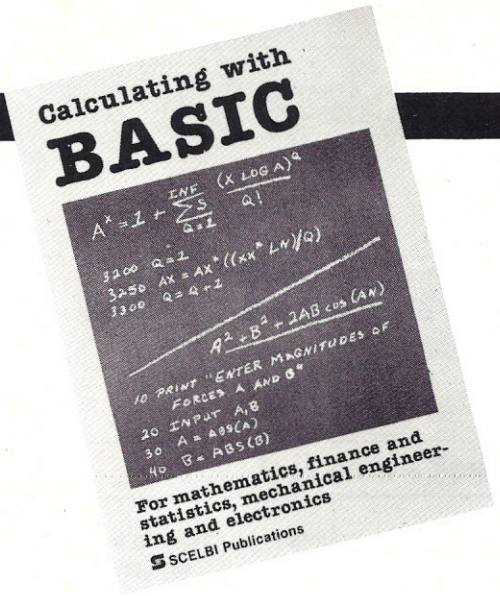


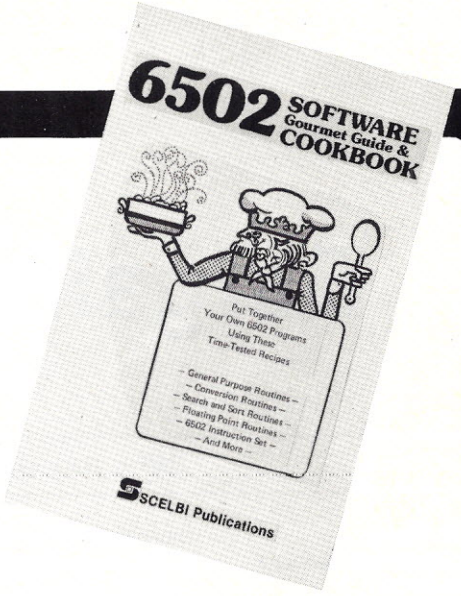
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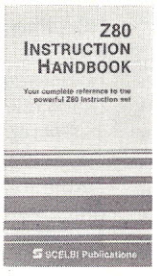
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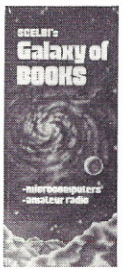
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Bargain-Basement '80

Why pay $200 for Radio Shack's monitor?

Russell W. Steele
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Shortly after Radio Shack introduced the TRS-80, I was sure it was the system for me. Impressed by its user-oriented configuration, with BASIC in ROM, standard typewriter keyboard and modest price, I ordered one as soon as I could. To save my limited cash for future peripherals, I only ordered the CPU keyboard, planning to modify a b and w TV to serve as the monitor. In this article, I would like to share with you some of the trials and tribulations of TV conversion and, at the same time, explain how I accomplished the modification.

My initial plan was to modify the old b and w TV collecting dust in my workshop while I waited for the computer to arrive. I soon abandoned this idea as the old set was full of hot tubes and high voltages. Rather than attack these problems head-on, I chose to buy a new solid-state set for my conversion project.

Shopping around to find a bargain, I found a 9-inch RCA model AX095E on sale for under $100 at a local discount store. I had looked at sets that ranged from $69 to over $150, hoping to find one with a transformer power supply, but there were none available in the local area.

Discussing the problem with several TV repair shop owners, I found out that most late-model sets do not have power transformers. The transformers are expensive, and at today's prices, every penny counts.

A power transformer or an alternative was essential to avoid hot chassis problems. In subsequent weeks, I visited pawn shops and used-TV stores and searched the want ads in the morning paper, looking for a transformer-powered, solid-state TV set. I even posted a note on the office bulletin board. No luck!

It was weeks later when I spotted the 9-inch b and w on a scratch and dent sale. It cost more than I had planned to pay, but it was designed to work on both 117 volt ac and 12 volt dc. By using a 12 volt CB power supply to run the TV set, I solved my isolation problems. Someday, I'll install an inexpensive isolation transformer and return the 12 volt power supply to its intended purpose.

Two added benefits I hadn't anticipated were the TV set's color scheme and a convenient handle. As you can see from Photo 1, the TV's black and silver case matches the TRS-80. The handle is not quite visible in the photo.



Photo 1. The TRS-80 with converted TV set on the workbench. (Photos by Jim Damman)

Planning

In the initial months after the TRS-80 was announced, there wasn't much technical data available about the system I/O ports. I wrote Radio Shack in Fort Worth requesting more technical data, and they answered my letter with a telephone call, only to say the information would come with my computer. I was beginning to think I would have to wait for the computer to arrive before starting the conversion.

My confidence received a big boost when the first *Radio Shack Microcomputer Newsletter* arrived—it had some of the needed data. The video output is a 75 Ohm, 1.4 volt peak-to-peak non-interlaced signal with a 6 MHz bandwidth. Information on the input connectors was missing, but I now had enough data to start on the interface.

A thorough review of Don Lancaster's *TV Typewriter Cookbook* produced more than enough information on how to build a direct video input circuit with a 5 MHz bandwidth. I highly recommend this book to anyone attempting to convert a TV set to a monitor.

One of the first items on Don's conversion checklist is a complete schematic for your TV set. I found the AX095E in the Howard Sam Photo Factfolder 1, Set 1526. Using the schematic and the information provided on page 190 of the *TV Typewriter Cookbook*, I laid out the circuit diagram shown in Fig. 1. Making sure the parts listed in Table 1 were on hand, I

RCA Phonojack	1
Resistor, 470	1
Resistor 4700	1
Diode, 1N914 or 1N4148	2
Capacitor, 0.1 uF	1
Terminal Strip (4 Lug)	1
Shielded Cable	26 in.
DIN Plug, 5 pin (Radio Shack 274-003)	1

Table 1. Parts list for modification.

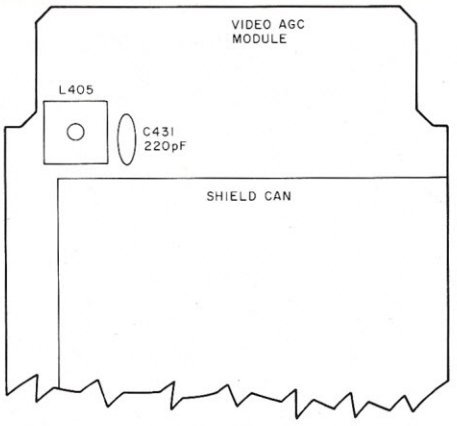


Fig. 2. The sound trap capacitor C431, 220 pF, is located next to coil L405 on the video AGC module. This coil and capacitor are not visible in the photos.

started the modification.

Construction

First, lay the TV face down on a soft cloth to prevent any scratches on the screen and remove the five screws holding the back of the cabinet. You will have to position the power-selection switch to "internal battery" to remove the cover. Once the cover is off, locate the video AGC circuit board. It's the one next to the tuners on the left. This board is shown in Photo 2 with the support bracket in place. The bracket is easily removed.

I also removed the shield attached to the VHF tuner to give me more room to lift out the circuit board. The board is held in place by clips at both ends. Use a long screwdriver to work the clips as you pull up on the board.

With the circuit board removed, position it on the workbench with the shielded box down. The two test points protruding through a shielded cover should be on top. Locate test point TP 403 (A in Photo 2) and resistor R424 (not visible) and carefully cut the trace between them at the base of the test point with a sharp blade. I used an X-acto knife to cut out a small section of the PC trace, leaving enough trace so that the circuit could be restored if you wanted to return the set to its original condition.

Test point 403 now becomes the computer's video entry point. However, when the trace

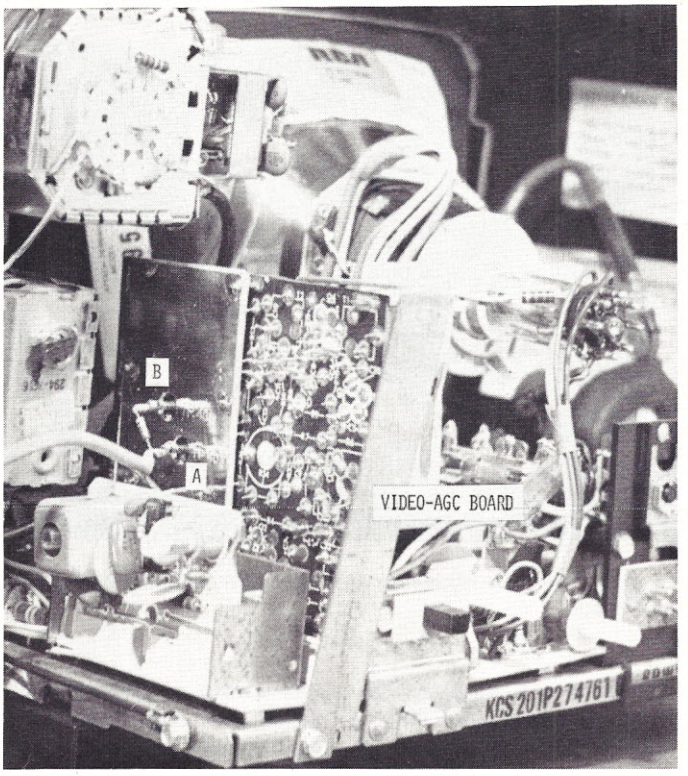


Photo 2. The video AGC board installed in TV set. "A" is test point T403 and the video entry point. "B" is test point T405.

was cut, we removed the bias to Q406, the first video amplifier, which should be approximately 2 volts.

There are a number of solutions to this problem, but the easiest is to connect a 4700 Ohm resistor from TP 405 (B in Photo 2) to TP 403, which restores the dc path for the bias voltage. Next, install a jumper across capacitor C431, the 220 pF ceramic next to the coil can. Fig. 2 shows its exact location. This disables the 4.5 MHz sound trap and improves the video bandpass.

Building the video input circuit is relatively easy. Strip 1 1/2 inches of insulation from an 8 inch piece of shielded cable. I used some audio cable, but any mini coax is OK. Solder the center conductor of this cable to TP 403 and the braid to the top of the large shielded box near the test point. This is illustrated in Photos 2 and 3. The other end will be connected to the video input circuit.

This circuit is built on a terminal strip using the circuit shown in Fig. 1, in heavy dark lines, and the parts layout in Fig. 3. Note the position of the bands on the diodes when soldering them in place. These diodes are placed in series with the 470 Ohm resistor to adjust the input bias to approximately 1.2 volts. This bias adjustment is necessary to blank the screen when the video signal is not present. A 0.1 uF capacitor is placed across the two diodes.

Lug A of the terminal strip is the common point for this circuit. Both the coax shield and

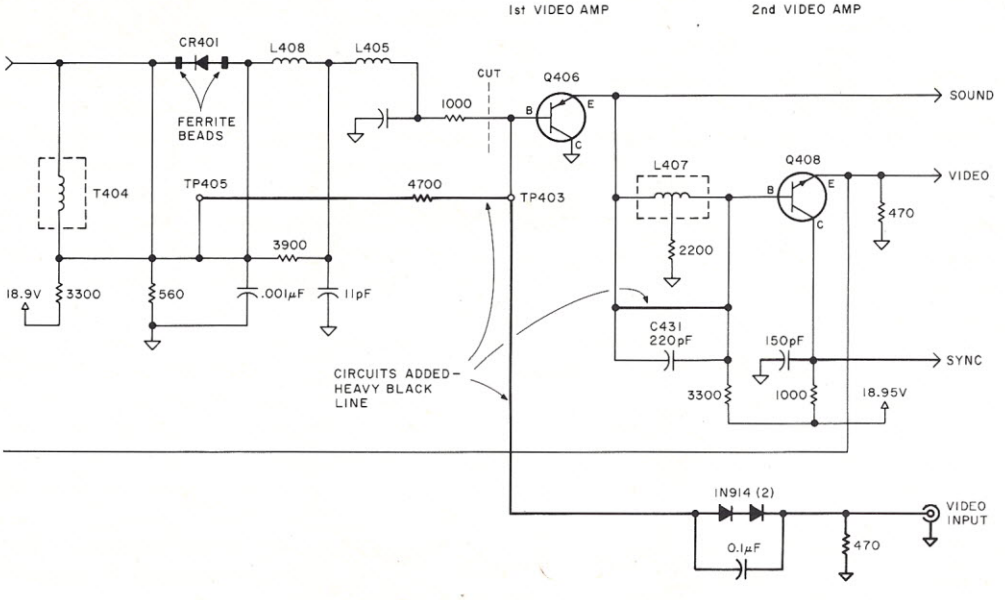


Fig. 1. Schematic of first video amp with video input circuit drawn in heavy black lines.

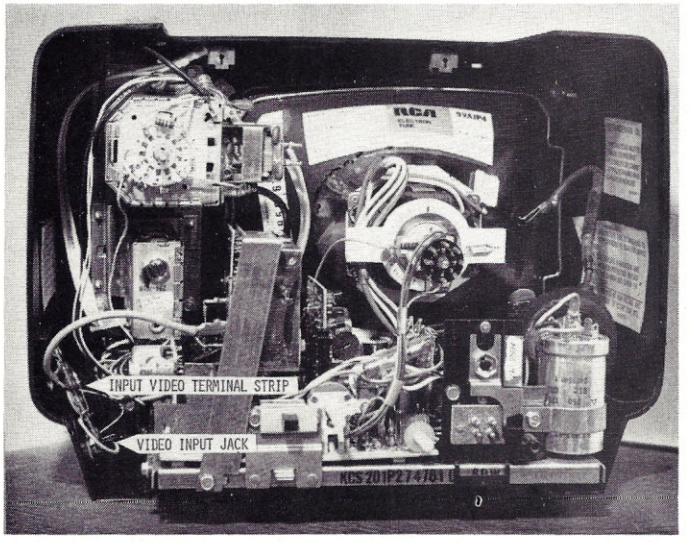


Photo 3. The video input jack and video terminal strip installed in the TV set.

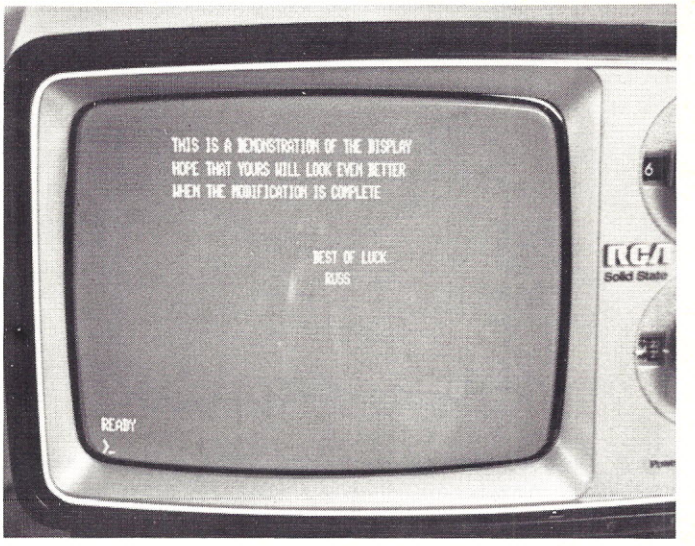


Photo 4. Modified TV with a message generated by the TRS-80.

the input jack ground should be tied to this point when the terminal strip is in place. It is held in place by slipping the mounting lug under one of the video jack mounting screws. I used an RCA audio jack for the video jack.

Photo 3 shows the location of both the video jack and the terminal strip. This jack is located approximately 1 1/2 inches in from the edge of the case. It's centered on the flat portion as shown in Photo 3.

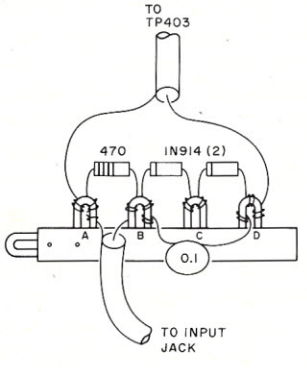


Fig. 3. Layout of the video input circuit on a four-lug terminal strip. Each lug is assigned a reference letter. See the text.

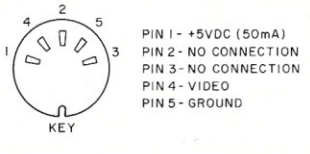


Fig. 4. The TRS-80 video output plug viewed from the rear of the TRS-80 keyboard.

One note of caution when drilling the holes for the jack: The plastic is soft, and a large bit in a power drill will go through before you can stop it. Use a hand drill or drill a small hole and ream it with a sharp knife or other suitable tool. When you drill soft plastic, patience has its rewards.

With the video jack in place and the terminal strip positioned, solder the video input cable center wire to lug D (Fig. 3), and the shield to lug A. This shielded cable should now run from TP 403 to the terminal strip. Next connect the center contact on the audio jack to lug B and the ground to lug A. Check all connections and solder joints prior to installing the back cover. Double-check the circuit with the schematic in Fig. 1.

The TV modification is complete, but I still needed some information on the TRS-80 video output jack. I paid a visit to the local Radio Shack store hoping they could shed some light on the problem. It was a lucky day — for them and for me — as they had just received their first TRS-80. A quick check in the instruction manual showed the video output plug to be a 5-pin DIN audio jack, part number 274-003. Most stores carry this plug in stock. The pin connections for the jack are shown in Fig. 4. This same information can be found on page 228 of the TRS-80 Level I user's manual.

Using 18 inches of shielded audio cable, I put an RCA plug on one end and the DIN plug on the other. The center conductor goes to pin 4 and shield to pin 5 of the DIN plug. With both plugs installed, the cable is now compatible with the computer and the monitor.

Operation

It was a family event the day I brought the computer home, but by the time I had unpacked it and had read all the instructions, everyone had lost interest. With growing excitement, I hooked the TRS-80 to the converted TV set and turned them both on.

At first, I had nothing but garbage on the screen. I turned it off and back on again and the garbage went away, but the letters were smeared. By adjusting the contrast and brightness controls, I was able to clear up the letters and produce a crisp display.

Photo 4 shows the final results on the screen of the modified TV set. At this point, all work stopped until everyone in the family had played a game that comes with the computer. The project appeared to be a success. Now it was time to do some serious programming and find out if the TRS-80 would satisfy my long-term needs.

Other Considerations

In attempting a similar modification, it's important you either avoid hot chassis sets or take the necessary precautions, as a severe shock hazard can exist when you use this direct-video-entry method described above. It's a 50-50 chance the hot side of the power line is hooked to the chassis. Even a three-prong plug won't protect you if the outlet you're using is not properly wired and grounded.

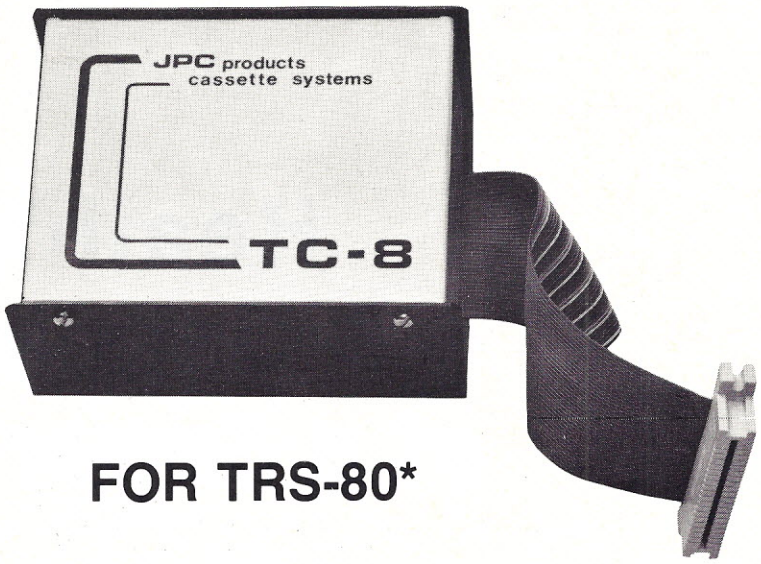
I highly recommend an isolation transformer or separate power supply. Some of you may have observed the polarized plug on the Radio Shack monitor. The monitor has a hot chassis; however, it's isolated from the computer by a 6N135 optical-isolator.

Summary

Using a b and w TV for a monitor can save you money; however, I did not save as much as I had initially planned. Regardless, I am satisfied with the results and have learned a great deal about the operation of my system, especially the video interfaces. I prefer the 9 inch display over the larger 12 inch TRS-80 display. The TV set's black and silver color scheme matches the keyboard console to create a professional-looking system. Given a choice, I would certainly choose this option, and, with the confidence I've gained, I plan some more interface modifications to my system. ■

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Heath's H19: A Detailed Look at a Super Terminal

Before terminating your search for a "glass" TTY, consider this beauty from Heath.

HEATH MODE	ANSI MODE	TERMINAL ACTION	SPECIAL KEY?
ESC A	ESC [ϕA	CURSOR UP	↑
B	[ϕB	CURSOR DOWN	↓
C	[ϕC	CURSOR RIGHT	→
D	[ϕD	CURSOR LEFT	←
E	[2j	CLEAR DISPLAY	shift ERASE
F		ENTER "GRAPHICS" MODE	
G		EXIT "GRAPHICS" MODE	
H	[H	CURSOR HOME	HOME
I	[M	REVERSE INDEX	
J	[j	ERASE TO END OF PAGE	ERASE
K	[K	ERASE TO END OF LINE	
L	[ϕL	INSERT LINE(S(	IL
M	[ϕM	DELETE LINE(S)	DL
N	[ϕP	DELETE CHARACTER(S)	DC
O	[4ℓ	EXIT "INSERT CHARACTER" MODE	
Y	[ℓ;cH	DIRECT CURSOR ADDRESSING (= line; c= column)	
Z		IDENTIFY AS VT52™	
ESC b	[1j	ERASE BEGINNING OF DISPLAY	
j	[s	SAVE CURSOR POSITION	
k	[u	SET CURSOR TO SAVED POSITION	
ℓ	[2K	ERASE ENTIRE LINE	
n	[n	CURSOR POSITION REPORT	
o	[1K	ERASE BEGINNING OF LINE	
p	[7m	ENTER "REVERSE VIDEO" MODE	
q	[m	EXIT "REVERSE VIDEO" MODE	
rα	[βr	MODIFY BAUD RATE	
t	[>6h	ENTER "KEYPAD SHIFTED" MODE	
u	[>6ℓ	EXIT "KEYPAD SHIFTED" MODE	
v	[?7h	WRAP AROUND AT END OF LINE	
w	[?7ℓ	DISCARD AT END OF LINE	
xΔ	[>Δh	SET MODE (SEE TABLE 2)	
yΔ	[>Δℓ	RESET MODE (SEE TABLE 2)	
z	[z	RESET TO "POWER-UP" CONFIGURATION	shift RESET
ESC @	[4h	ENTER "INSERT CHARACTER" MODE	IC
<	[?2h	ENTER "ANSI" (OR HEATH) MODE	
=	[>7h	ENTER "ALTERNATE KEYPAD" MODE	
>	[>7ℓ	EXIT "ALTERNATE KEYPAD" MODE	
[	[>3h	ENABLE "HOLD SCREEN" MODE	
\	[>3ℓ	DISABLE "HOLD SCREEN" MODE	
}	[2h	DISABLE KEYBOARD	
{	[2ℓ	ENABLE KEYBOARD	
]	[q	TRANSMIT 25th LINE	
#	[p	TRANSMIT PAGE	

ϕ = an optional number in ANSI mode. Specifies number of repetitions
α = a mandatory number in Heath mode. Sets baud rate.
β = a mandatory number in ANSI mode. Sets baud rate.
Δ = a mandatory number in either mode. See Table 2.

Table 1. Escape sequences.

Heath's incredible new video terminal, which should be of great interest to all microcomputer users, has finally been released. The assembled price of $995 is an outstanding value, but the kit price of only $675 will surely blow the socks clear off all the competition. In other words, the party is *already* over for that other new terminal.

This highly sophisticated unit, the H19, is a Z-80-controlled intelligent terminal. It is loaded with many "most wanted" features, such as graphics, reverse video and 25 lines of 80 characters, including a 25th status line. In addition, there are upper and lowercase *with descenders*, both line *and character* editing, direct cursor addressing and much more.

Virtually all of its special functions can be controlled from the host computer or from the keyboard of the terminal itself. This is done primarily with escape sequences, and the H19 will recognize and respond to about 100 of them (see Tables 1 and 2). The H19 will also generate 60 single key sequences. Of these, 20 perform some function within the terminal; the other 40 are

available for definition and use in your programs (see Table 3). The H19 will also respond directly to seven ASCII control codes (see Table 4).

The keyboard (Photo 1) has 84 keys and includes a calculator keypad. All 128 ASCII characters and codes can be generated, and the screen will print all 95 ASCII printable characters. There are eight user-definable special function keys. Keyboard feedback is an audible keyclick that can be disabled (and reenabled) with an escape sequence. The cursor and editing controls are on the keypad, which has some interesting extra features.

formed on a 5 × 7 dot matrix, but those characters with descending tails are formed by a 5 × 9 dot matrix. You can see this in Photo 3. Graphics symbols use a full 8 × 10 matrix.

The H19 communicates with the outside world through its own standard EIA RS-232C serial interface. This means that you can use this terminal with just about any computer system available today and, in most cases, simply plug it in. I wouldn't be at all surprised to see it used with many different minicomputers, too.

Special Features

There are far too many special features to describe in this article, so I will cover the main ones of interest to microcomputer users. I will try to explain them so that even an IBM engineer can understand.

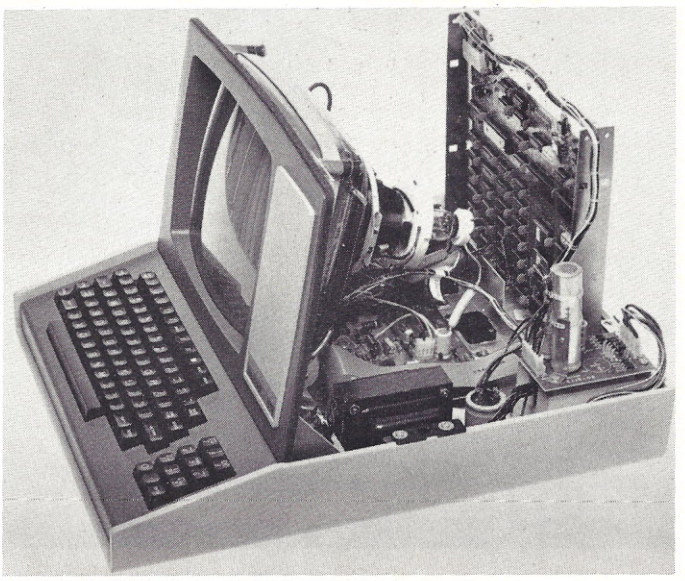


Photo 2. Overall view of the completed terminal with the top removed. Notice the open construction. The speaker is visible just behind the right side of the keyboard. Notice also the ribbon cable just behind the speaker that connects to the keyboard. The DIP switches are visible on the upper-right corner of the logic board.

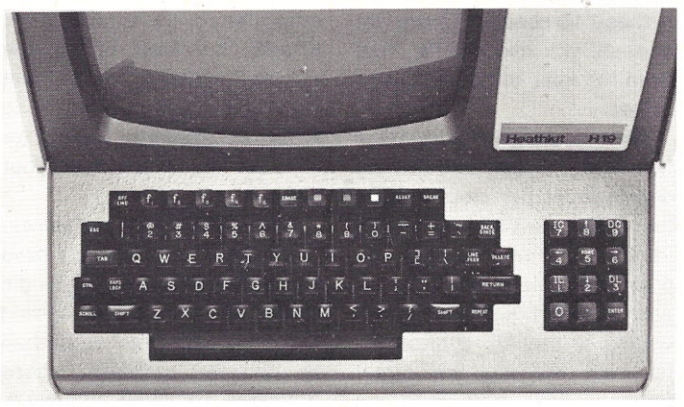


Photo 1. The H19 keyboard. Notice the special function keys across the top. The squares on the three keys to the right are colored blue, red and gray.

The cabinet deserves special mention. It is a fully professional molded plastic case with a very high quality appearance, designed for both the business and home environment. The top is hinged, in clamshell fashion, and all components mount to the bottom part, so that you can operate easily with the top open. In fact, the hinges separate, and you can take the top off in about five seconds. Photo 2 shows the H19 open with its top cover removed.

This versatile terminal will operate not only in the Heath mode and an ANSI mode, but will also directly replace and operate as a DEC VT52. This may explain some of the philosophy behind the excellent design of this unit.

Most screen characters are

Cursor. The cursor can be either an underline or a full block. You can also turn it off completely. When on, it always flashes and is nondestructive. All of these choices may be preset by switches on the logic board, but may be changed at any time from either the computer or the keyboard. For example, to turn the cursor off, you would type "ESC x5." From the computer, you can accomplish this by the BASIC statement PRINT CHR$(27);"x5."

Graphics. There are 33 graphics symbols available. You enter the graphics mode with the sequence "ESC F." In that mode, the keyboard will generate symbols instead of the usual letters. These symbols are not marked on the keys, so you will need to refer to your manual when working in the graphics mode. An "ESC G" will turn off the graphics. You can enter or exit this mode, and generate all symbols, from the host computer or from the keyboard.

Keyboard disable. This feature can be convenient for a terminal that is on public display. Typing (or sending) the sequence "ESC]" causes the keyboard to go dead except for the reset. To reactivate the keyboard requires an "ESC[" and you can no longer enter this from the keyboard, so it must be sent by the computer.

Heath and ANSI modes. In the Heath mode, the terminal generates and recognizes Heath escape sequences. In the ANSI mode, ANSI standard escape sequences are used instead. There is no great difference to the end user, but there are a few things you should know.

In the ANSI mode, the graphics symbols are not available. However, many of

HEATH MODE	ANSI MODE	EFFECT ON TERMINAL
ESCx1	ESC [>1h	ENABLE 25th LINE
x2	[>2h	DISABLE KEY CLICK
x3	[>3h	ENABLE "HOLD SCREEN" MODE
x4	[>4h	BLOCK CURSOR
x5	[>5h	CURSOR OFF
x6	[>6h	ENTER "KEYPAD SHIFTED" MODE
x7	[>7h	ENTER "ALTERNATE KEYPAD" MODE
x8	[>8h	AUTOMATIC LF ON RECEIPT OF CR
x9	[>9h	AUTOMATIC CR ON RECEIPT OF LF
ESCy1	ESC [>1l	DISABLE 25th LINE
y2	[>2l	ENABLE KEY CLICK
y3	[>3l	DISABLE "HOLD SCREEN" MODE
y4	[>4l	UNDERLINE CURSOR
y5	[>5l	CURSOR ON
y6	[>6l	EXIT "KEYPAD SHIFTED" MODE
y7	[>7l	EXIT "ALTERNATE KEYPAD" MODE
y8	[>8l	NO AUTOMATIC LINE FEED
y9	[>9l	NO AUTOMATIC CARRIAGE RETURN

Table 2. SET-RESET functions from Table 1.

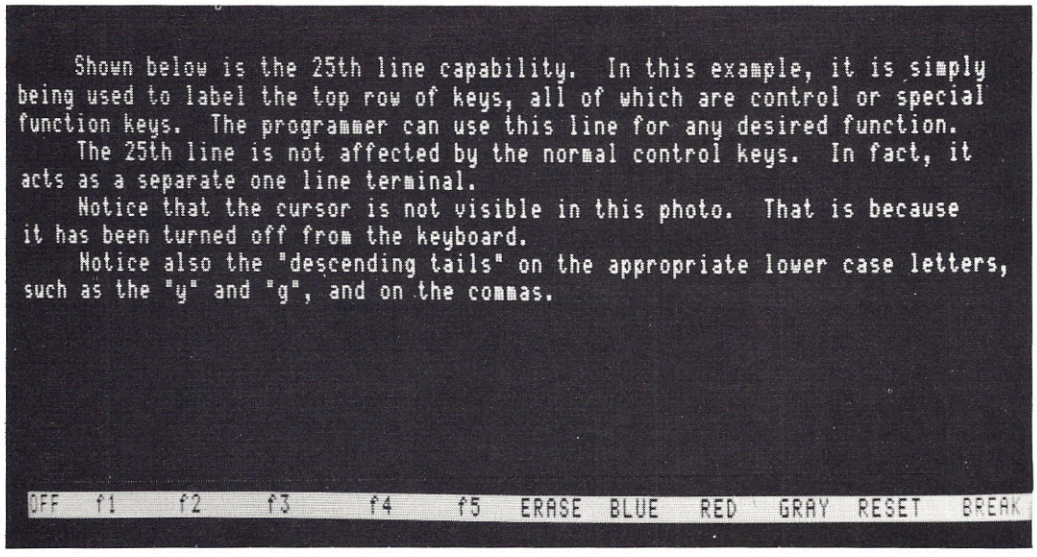


Photo 3. CRT screen showing the 25th line. Notice the clean characters, due to the wide bandwidth of the video circuits.

the ANSI cursor control and editing functions are more sophisticated. For example, to move the cursor nine spaces to the right, you could type the "→" key nine times in either mode. If you want to do this from the computer and you are in the Heath mode, you must send "ESC C" nine times. In the ANSI mode, however, you can send "ESC [9C" once, and the cursor will move nine spaces right.

You can have the best of both worlds, though, because an escape sequence causes the switch between modes. This means that you can first switch to whichever mode you want, then use its special functions, all under control of the host computer. Having both of these modes simply allows the terminal to be used with more different systems and software.

Special function keys. These eight keys, located along the top of the main keyboard, simply generate an escape sequence as shown in Table 3. Each key will automatically transmit one of two sequences, depending on whether you are in the Heath or the ANSI mode. These keys can be very useful, as your programs can be written to recognize the transmitted sequence and then perhaps branch to some special routine.

KEY TYPED	HEATH MODE	ANSI MODE
f1	ESC S	ESC O S
f2	ESC T	ESC O T
f3	ESC U	ESC O U
f4	ESC V	ESC O V
f5	ESC W	ESC O W
Blue	ESC P	ESC O P
Red	ESC Q	ESC O Q
Gray	ESC R	ESC O R
0	ESC ? p	ESC O p
1	ESC ? q	ESC O q
2	ESC ? r	ESC O r
3	ESC ? s	ESC O s
4	ESC ? t	ESC O t
5	ESC ? u	ESC O u
6	ESC ? v	ESC O v
7	ESC ? w	ESC O w
8	ESC ? x	ESC O x
9	ESC ? y	ESC O y
	ESC ? n	ESC O n
ENTER	ESC ? M	ESC O M

Table 3. Escape sequences generated by the special function keys and by the number keys on the keypad when it is in the Alternate Keypad mode.

If these 16 sequences are not enough, you can get 24 more from the keypad, as described below.

Keypad. As previously mentioned, the keypad also has the cursor controls and editing functions. As you can see in Photo 1, the numbers are the primary function, and you must use the shift key to get the editing and cursor controls. If, however, you use the cursor controls, say, more than the numbers, the Heath engineers have made things easy for you.

A Keypad Shifted mode is included, and in this mode, the keypad is electronically shifted for you. Now the cursor controls and editing keys become the primary function of the keypad, and you must use the shift key to get the numbers. You can set a switch on the logic board, so that the terminal will power up in this mode. But no matter where this switch is positioned, you can still change modes from the host computer or from the keyboard at any time. You may have guessed that this is done with an escape sequence.

There is still more to the keypad, however. You will recall that I mentioned that more escape sequences are available from the keypad. This is done by going to another mode, the Alternate Keypad mode. This mode eliminates the numbers from the keypad and, instead, will transmit preprogrammed escape sequences. These sequences are shown in Table 3. Note that the cursor control and editing functions are not affected by this mode. In addition, the Keypad Shifted mode can still be used.

The Alternate Keypad mode, as you probably know by now, is enabled and disabled by an escape sequence. There is no switch on the logic board for this function, so it must always be entered with an escape sequence.

Screen erase. Sorely missed by H9 (and many other) terminal users is a simple erase screen function. This terminal has corrected that problem very simply. Typing ESC E will clear the screen and send the cursor home. This can also be accomplished by typing shift ERASE, but best of all, the escape sequence can be sent from the computer. It is no longer necessary to send 12 (or 24) line feeds to clear your screen.

Configuration switches. Throughout this article, I have mentioned switches on the logic board that can preset certain functions. This is accomplished by two DIP switches, whose functions are listed in Table 5. The important thing about these switches is not so much what they do, but how they do it. They preset the "power up" mode of operation only, in most cases. That is, they preselect certain modes of operation, so that when you turn the terminal on, it will be in that selected mode.

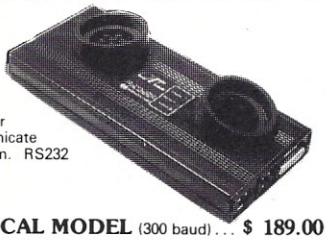
For example, if you usually operate in the Keypad Shifted mode, you can preset this on a switch so that you do not have to type the escape sequence

Control	G	Bell
	H	Backspace
	I	Horizontal tab
	J	Line feed
	M	Carriage return
	X	Cancel
	[	Escape

Table 4. ASCII control codes to which the H19 will respond directly. Note that the proper software can allow the terminal to respond to many additional codes.

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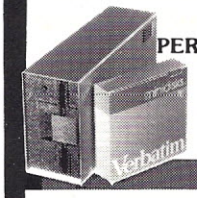
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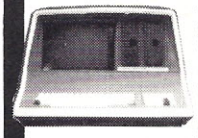
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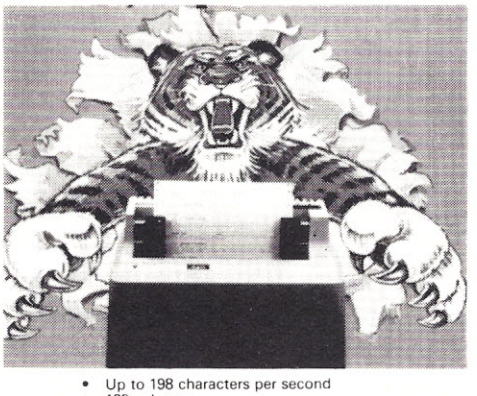


(Terminal) Z-80 controlled, 80 Char. by 24 lines, 128 upper and lower case, ASCII Char., graphic symbols, reversible video, half intensity video, special 25th display (status) line, 12" screen, operating mode: conversational, message, page, Char. insert/delete, line insert/delete, half or full duplex, keyboard with 18 key numeric pad, full cursor control, RS232 and 20/60 Ma loop auxiliary printer port, 75-9600 baud and a lot more special features all software controlled, no little mini-dip switches to bother with.

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MP/M 1.0	Z80	8"

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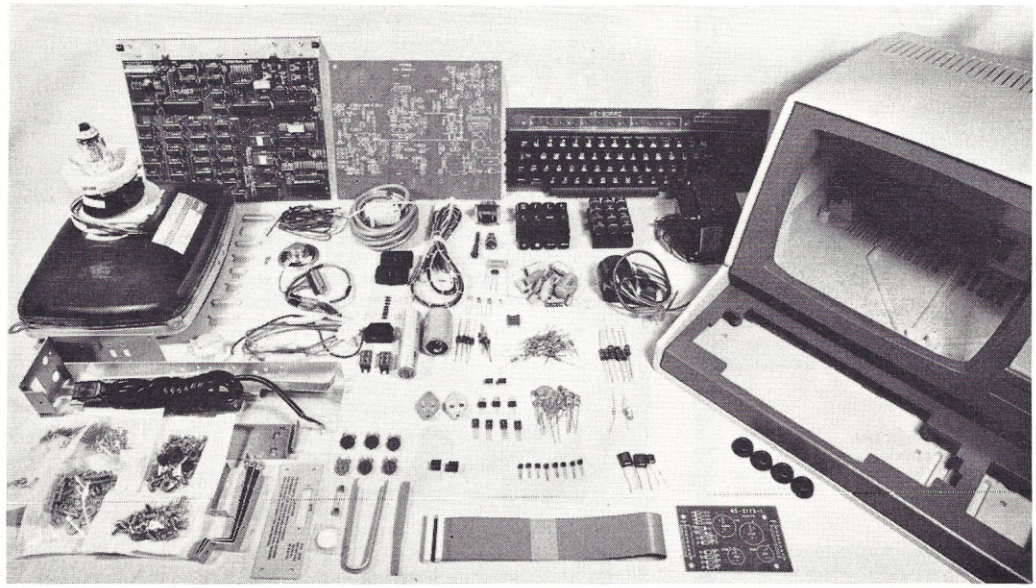


Photo 4. Kit parts before assembly.

each time you start the system. Of course, you can always override the switch from the keyboard if you want to change modes during operation. This is done with the normal escape sequence.

Reverse video graphics. The reverse video function works not only on the standard ASCII characters, but also on the graphics symbols. This effectively gives you 66 available symbols.

Hold screen mode. Many times you have had more than one page of data to display on your terminal, and when you are operating at high baud rates, the lines pass by too fast to read. Most terminals solve this with the CNTRL S function, which stops input until you type CNTRL Q. The H19 has that too, but it has something even better. It is called the "Hold Screen" mode, and when enabled, the terminal will accept data until the screen is full and then stop. It automatically sends CNTRL S to the computer for you.

When you are ready for more data, you can get one line at a time or one page at a time. Typing the scroll key will give you one new line each time you type it. Typing shift SCROLL will give you one new full page. You can continue this until there is no more data to view.

25th status line. The 25th line acts as s separate one-line terminal. It can show terminal status or other information as desired by the programmer. To use this line it must first be enabled with an escape sequence (what else?), and then the cursor must be sent to the 25th line with direct cursor addressing. Photo 3 shows this line in use. You must also use direct cursor addressing to get the cursor back out of this line, except that you can use the HOME key if you want the cursor at home.

There is an additional convenient feature connected with this operation: While still on the main screen (the upper 24 lines), an ESC j will cause the terminal to remember the current cursor position. After you have then gone to the 25th line and are ready to return, an ESC k will send the cursor back to the previously remembered position.

Construction

You can usually get a pretty good idea of the complexity of a kit by the difference between the kit price and the assembled price. In this case, you are greatly misled. Assembly is simpler than the price difference of $320 seems to indicate. Photo 4 shows the parts before assembly. The pre-assembled logic board is at the left rear; the partially assembled keyboard is at the right rear. Particularly notice the small stack of loose wire just in front of the logic board. That is all the wire needed.

Construction is to the point and very easy. Total assembly time takes about eight hours, which includes some extra time for things that I do to save myself later trouble. For example, I scrape all the way around the leads of all components, particularly transistors, with a penknife. This cleans them, and they then solder very easily, almost instantly. Much less heat is needed to apply to the component, and I have not had one "bad" transistor since I started using this technique.

There are only four circuit boards, and one of them, the logic board, comes completely assembled. Another, the keyboard, comes partly assembled. You add 24 keys and the board connector and then solder everything. Veterans of the H9 campaigns will be happy to know that the keys here are not the same. You can see them in Photo 4, just in front of the keyboard. They come in blocks and install very simply. Incidentally, the keyboard terminates in a standard 34-pin connector, and Heath has supplied a preassembled ribbon cable to connect your keyboard to the logic board. Total assembly and connection time for the keyboard is about thirty minutes!

The remaining boards are the power supply and the video board. The power supply, the little one in the right foreground of Photo 4, assembles in about thirty minutes. The video board takes about three hours.

Perhaps the best part is that there is an absolute minimum of point-to-point wiring. The kit comes with some brown, some green, some black and some bare wire. The brown wire is all used up in running two wires to the speaker. The green is only for the ac line grounds; the bare wire is mostly for a safety ground for the CRT.

There are maybe a half dozen jumpers here and there, and then all that is left is about three feet of black wire that is used to hand-wire the ac line to the power transformer. The setup is similar to the H8 computer in that there is a switch to select 110/220 volts and another for NOR/LOW voltage. The similarity ends there, however, and you will like the way the ac wiring is done on a separate subpanel. This panel then mounts neatly inside the rear of the main cabinet. The two switches remain accessible from outside the cabinet.

There is only one wire harness, which is almost completely assembled, *including plugs.* You will only have to solder four wires from this harness to the filter capacitor.

Photo 2 shows the assembled terminal, and you can see the open, uncluttered design. This unit is a pleasure to put together. The completed H19 is shown in Photo 5.

Operation

Operation of the terminal presents no special problems, but it will take you a few days to get used to the multi-key escape sequences. A background as a concert pianist may help you here.

You will at first make a few errors between upper and lowercase, too. ESC J is not the same as ESC j. But the keyboard is of excellent design, and in just a few days you will find that you have become a veritable virtuoso of the keys.

Before starting, you must set up the terminal for line frequency, baud rate, desired parity con-

figuration and full or half duplex operation. All other options may be set after start-up. If you are using a Heath computer system and have the H8-4 serial board, you do not need to set the baud rate. This is because the H8-4 board, in conjunction with the Heath software, will automatically operate at whatever baud rate has been set on your terminal. The H19 will operate at any standard baud rate up to 9600.

If you have been using the H9 terminal from Heath, there is one difference that is quite important. There are only a couple of local function keys on the H19. In other words, nearly all keys will send a code to the computer. If you forget this, it will cause you all sorts of mysterious syntax and other errors. You can inhibit the sending of codes by holding down the CTRL (control) key, and you must remember to do this when doing screen erases and other terminal functions. You will probably forget this a few times, and you will wonder what happened to your BASIC program.

Software Notes

To use all the fascinating features of the H19, you will need an extended BASIC with a CHR$ function. With this function, you can send any escape sequence to the terminal and make it do almost anything.

Unfortunately, the editing features are not usable with present-day software. Heath is working on a word-processing program that should be available soon. It was partially demonstrated at the NCC in New York last June and was impressive.

The problem with software is that the escape sequences generated by the terminal are not recognized by the program. If you try to use the editing functions while you are in BH BASIC or TED-8, you will cause all sorts of peculiar errors in your programs. This usually doesn't cause much anguish because most of your escape sequences will be sent the other way, that is, from the computer to the terminal. This is done with the CHR$ function.

Naturally, if you are an experienced assembly- or machine-language programmer, then you can write your own software and take full advantage of all of the features of the H19.

The Negative Side

This terminal has a few shortcomings. In order to keep the cost low, Heath has left out some popular features such as blinking characters, protected fields, half-intensity video and auto-repeat keys. Some functions are more complex than they were on the H9, too.

For example, the screen erase was a single-key function on the H9 and was also a local function. That is, it sent no codes to the computer. The H19 also has an erase key, but it is an "erase" to end of page, which sends an escape sequence to the computer. You can change it to an "erase screen" by holding down the shift key, and, of course, you must also hold down the CTRL key as mentioned earlier. So now it takes three keys to do what one did before. And that key was used so often, too. Oh well, it's not uncommon to lose something when you buy a better peripheral from Heath. (Stop me if you've heard this one—buy a disk, lose your expensive tape.)

Other Considerations

In buying any product of this sort, particularly in the microcomputer field, you should carefully consider the company that makes the product. Despite the few stones I have cast in their direction, Heath is a well-known, stable company that makes high-quality products. They have been around for years, and should be here for many more.

They are justifiably famous for at least two things: their customer support and their manuals. Their technical consultant program is an excellent example of the first. If you have any problem with a Heath product, you can call a consultant, who will assist you. In the early days of this program, it wasn't a lot of help, but things have changed now. The lines are manned by some consultants who really know their stuff.

Of course, the manual for this terminal, like all Heath manuals, is outstanding.

Summary

Although there are a few things not included in this terminal, there is no doubt that it is by far the best value available today. There are a number of terminals made just for the microcomputer market, some costing nearly $1500, that are all inferior to the H19 in features, price or both.

Assembly is so easy that I wouldn't hesitate to recommend this kit to the first-time builder. As long as you use a pencil iron of no more than 40 Watts and receive a little instruction on soldering, you should have no trouble putting this kit together.

If you run into any problems, not only are the Heath consultants available, but also your local Heathkit center is usually very helpful. In my area, the Heath store in Anaheim has been outstanding, both to me and to others, in helping with any problems that have arisen. They are never too busy to give you a few minutes and answer questions or help you with whatever you need to get you going again.

In conclusion, I think that if you have recently bought, or are about to buy, a terminal that doesn't say H19 on it, you have made a serious mistake. ■



Photo 5. The completed terminal.

S401-0	Sets baud rate
-1	"
-2	"
-3	"
-4	Enable/disable parity
-5	Odd/even parity
-6	Normal/stick parity
-7	Half/full duplex
S402-0	Underscore/block cursor
-1	Enable/disable key click
-2	Discard/wrap-around end of line
-3	Enable/disable auto line feed on carriage return
-4	Enable/disable auto carriage return on line feed
-5	Heath/ANSI mode
-6	Enable/disable "Keypad Shifted" mode
-7	50/60 Hz

Table 5. Functions of the two 8-pole DIP switches on the logic board. Note that these switches merely set the power-up configuration, and most functions may be changed at any time from the computer or from the keyboard of the terminal.

Improve Your AC-30

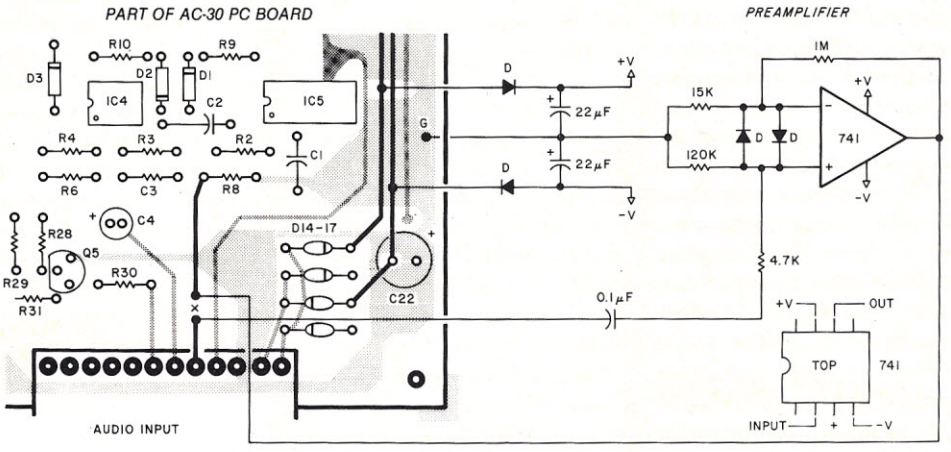


Fig. 1. Circuit modification.

Riemer Runia
Dr. Peter Vijlbrief
Dept. of Radiology
University of Leiden
The Netherlands

The SWTP system is quite popular in Holland. But we have met several people who have found difficulties in matching their recorders to the input side of the AC-30 cassette interface. This interface needs 4 to 5 volt peak-to-peak undistorted audio. And this value proved to be rather critical.

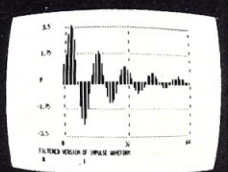
So we added an extra audio stage, which proved to be a great improvement. It amplifies the recorder output about 60 times and acts as a limiter for too large signals, so the volume setting of the recorder is not critical anymore.

We mounted this preamplifier on a small piece of vectorboard. On this same board, we also mounted the two diodes and capacitors used to filter the dc coming from the AC-30 printed circuit foils. We used a thick copper wire for the ground connection (bottom side of the AC-30 print), which also serves as a mounting support for the whole preamplifier board. Four other wires connect the preamplifier board to the main print.

The raw ± dc are taken from two printfoils running from the rectifiers on the main board. A foil break is made in the audio input circuit, and both ends are connected to the input and the output, respectively, of the preamplifier. Fig. 1 shows how this is done.

The preamplifier is built around a 741 operational amplifier. The diodes across the + and – inputs serve as protectors for too large audio input signals that may damage the operational amplifier. ■

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If you happen to be the proud owner of a Sorcerer by Exidy, you probably already know what to do. If you aren't, read on.

The Sorcerer comes with a set of 64 graphic characters, similar to the PET's, which are accessed through the use of a special graphics key. These are resident in ROM, but on power-up they are copied into a section of user-addressable RAM. This makes it possible to alter the codes, thus creating your own graphics characters. You could conceivably store the entire Hebrew alphabet in this special section of RAM, to be called out as easily as the ABC's. What's more, there is another section of blank RAM just waiting for you to program it with 64 *more* special characters, for a total of 128 user-defined characters.

```
10000001 = 81
01000010 = 42
00100100 = 24
00011000 = 18
00011000 = 18
00100100 = 24
01000010 = 42
10000001 = 81
```

Fig. 1. The graphics character associated with the Q key, with the hex codes to the side.

```
00010000 = 10
10101001 = A9
10010010 = 92
01111100 = 7C
00010000 = 10
00010000 = 10
00101000 = 28
01000100 = 44
```

Fig. 2. The stick-figure man drawn in the 8×8 matrix with hex codes.

Altering a Character

To begin with, each character is set in an 8 × 8 dot matrix, and is stored in memory as eight hex-encoded 8-bit bytes. To see how this is done, look at the graphics character associated with the Q key. It consists of two diagonals crossing each other to form a large X. If we think of the on and off dots as being 1s and 0s, this character can be expressed as eight binary bytes (see Fig. 1). Each 8-bit byte is then divided into two 4-bit nibbles and encoded in hex-code (see Table 1).

This character is located in the Sorcerer's memory in the addresses FC70 to FC77. Let's redefine this character by entering new codes into these addresses. Fig. 2 shows a simple stick-figure man drawn in an 8 × 8 matrix, with the coinciding hex-codes to the side. If we now enter these codes into the addresses FC70 to FC77, our stick man will be our new graphics character.

First we exit BASIC. Do this by typing "BYE" followed by a carriage return (:cr:). The > prompt appears to remind us we are now in the machine-language monitor. Type in the command "ENTER FC70 :cr:". The machine responds with "FC70:" so we enter "10 :cr:". The address increments to "FC71:" so we may input "A9 :cr:".

We follow this sequence until all eight hex-bytes have been entered. We now return to BASIC by typing "PP :cr:". Now when we hold down the graphics key while hitting Q, our little man appears. He's become our new graphics character!

Want to have some fun? Using the cursor controls, put the special character on the video screen, over in the lower right-hand area of the screen where it will be out of the way, but where it will be visible. Now go through the redefining process again, putting new codes in the addresses FC70 to FC77.

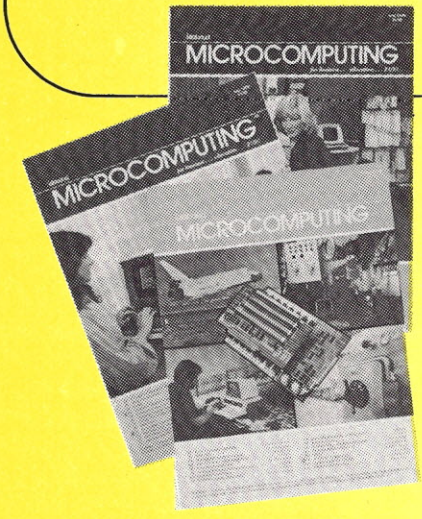
As each code is entered, watch the character. It changes to match the codes you're putting in. This happens because the video display must be continually refreshed by scanning memory. As we change the codes in memory, the character on the screen is also being updated.

```
0000 = 0  0100 = 4  1000 = 8  1100 = C
0001 = 1  0101 = 5  1001 = 9  1101 = D
0010 = 2  0110 = 6  1010 = A  1110 = E
0011 = 3  0111 = 7  1011 = B  1111 = F
```

Table 1. Hex encoded 4-bit nibbles. This code is used to store the graphics characters in their locations in memory. Thus, the code A9 represents the byte 10101001.

The addresses of the 128 user-definable characters may be accessed through BASIC commands PEEK and POKE, as well as the method described above. This means that character definition may take place under software control. This feature of Exidy's Sorcerer is, as far as I know, unique, and is extremely attractive. The ability to self-define graphics makes the design of game programs, animation, etc., an exercise in innovative thinking, and Sorcerer owners ought to be turning out classy programs right and left. I would if I owned one! ■

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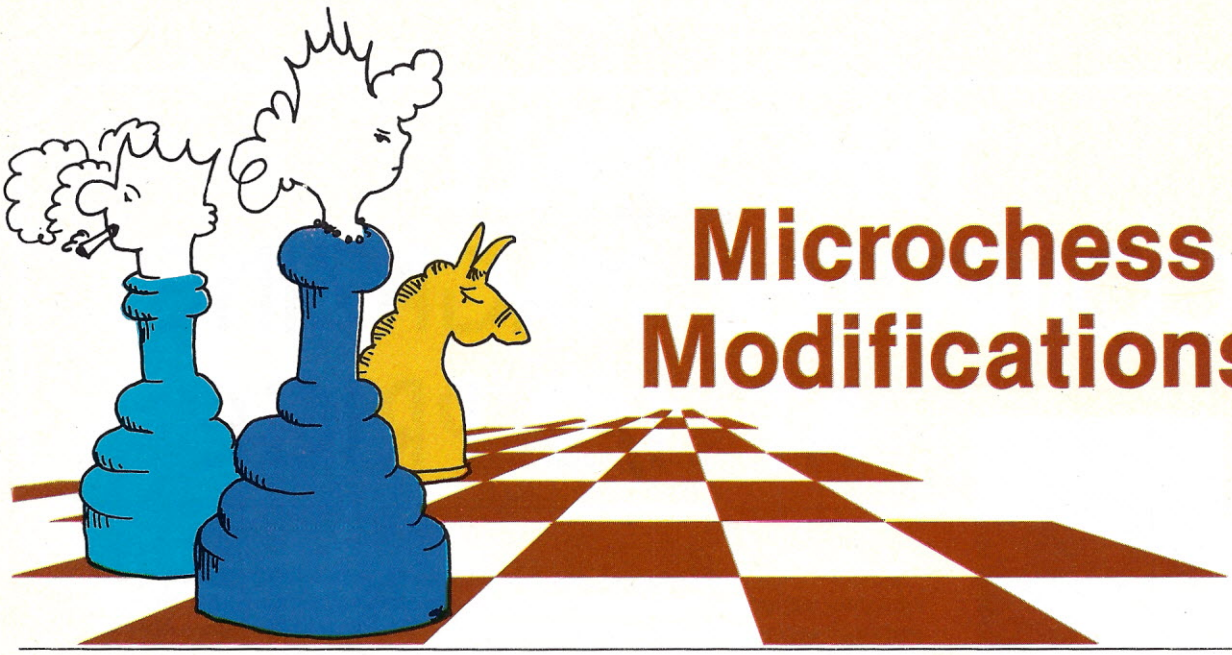
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Microchess Modifications

Enhance this computer chess game with these modifications.

Chris McCormack
116 Milburn Lane
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Microchess is a chess-playing program, written by Peter Jennings, designed to run on a 6502-based microcomputer system. Though it was configured for the Commodore KIM-1, the documentation contains suggestions on how it may be modified to run on other 6502 systems.

Remarkable about Microchess is that it can run on an unexpanded KIM, using only 1K of RAM. Though certain special moves (castling, en passant pawn captures, queening eighth rank pawns, etc.) cannot be made by the computer, it is possible for a human player to make these moves.

Poor Computer Play

Microchess was one of the first pieces of software that I was able to run on my KIM. I was elated to find that the program actually worked. For the next several weeks, I spent most of my free time sitting at the computer, playing one game of chess after another, never giving a moment's thought to how the program might operate.

After a while I became dissatisfied with the way the computer was playing. One of the main problems I noticed was that the computer would often move its queen time and time again, almost totally disregarding the other pieces at its disposal.

My second complaint was related to this. Because the computer was so preoccupied with its queen, it had a tendency to develop its minor pieces (knights and bishops) very slowly, if at all. Even if they were moved, they would often end up on a less than optimum square.

The final problem was that the computer was apathetic toward occupying the center of the board. Anyone who has tried to study chess has heard, time and time again, that the center is the most important area of the chessboard. In most cases, the player who has control of the four center squares will ultimately come out of the contest as the victor.

With these faults in mind, I decided to try to find out why the computer played the way it did. To begin my search, I read the programming manual supplied with the program. To my surprise, this approach yielded results almost immediately.

Changing Attitude

In the program, one of the criteria used by the computer to compare moves is mobility. The greater the mobility resulting from a move, the greater the appeal of the move to the computer. In order to reflect the unparalleled strength and mobility of the queen, a one-point bonus would be awarded whenever the computer moved the queen. This bonus was what convinced the computer to disregard the other pieces and constantly move the queen.

I felt that this bonus would have to be deleted or modified. Looking through the listing (also supplied), I soon found this section of the program. At address 0112, the piece being considered for a move is compared to the queen. If the piece is not the queen, a conditional branch is taken. If it is the queen, the instruction at address 0116 (F6) increments the mobility counter.

Instead of NOPing the six bytes involved (which would have resulted in a total one point less than the original coding), I decided to replace the increment instruction at address 0116 with a decrement instruction (D6). This gives a two point difference from the original. By doing this, the computer will now favor the other pieces on the board instead of the queen.

Openings

With the queen taken care of, there were only two more problems to contend with. The manual also supplied a partial solution to one of these problems: the computer's clumsy development of its pieces.

In an effort to counter this problem, the program includes provisions that allow the computer to play a stored opening of up to nine moves. This provides sufficient time to properly post the minor pieces. Besides this obvious advantage, there is a bigger bonus available to the computer when it plays a stored opening. That bonus is castling.

In normal play, the computer is unable to castle because it is considered an illegal move (moving two pieces at once, moving the king two squares, having one piece jump another). However, during the opening, the computer doesn't generate any of its moves. It simply plays whatever is stored in memory.

Using the opening has its limitations. Because of the limited memory available, only one opening may be stored in the computer to be used during a game. This leaves the computer with no flexibility in playing the opening. Once a move that contradicts the prestored sequence of moves is made, the computer will abandon the opening and generate its own moves for the remainder of the game.

In order for the computer to reap the greatest benefit from the opening, several factors

must be kept in mind: (1) castling in the shortest and most efficient manner, (2) quick development of the minor pieces, (3) obtaining a position from which the computer may assert or contest control of the center.

After a little research, I realized that an opening similar to the Ruy Lopez given in the programming manual (see Table 1) seemed to be what I was after. I particularly liked its allowing the computer to castle in only four moves.

But it also contained some moves I really didn't care for. By playing bishop to N5 (move 3), the whole opening is jeopardized because the common reply is 3: . . . P-QR3, forcing the bishop to retreat and the computer to abandon the opening. Instead I prefer 3:B-B4. Though it is conservative, it improves the chances of continuing the opening.

I also didn't care for the moves following 4: . . . N × P. Here the computer is looking for moves that I have yet to see anyone play. White's fifth move is particularly questionable because it allows black to make any move it wants, which is rarely the expected 5: . . . B-K2. I feel that 5:P-Q3 is a stronger move. Besides forcing the knight to move, it also opens up the queen bishop. Many people, being content with the free pawn, will simply retreat to B3.

This allows white to continue with 6:N-B3. Black will often respond with B-B4 in order to prepare for castling. Now white can play 7:B-K3, attacking black's bishop. Black will usually respond P-QN3. (If black plays B × B, the computer will respond with P × B, opening an important file for the king rook, as well as strengthening the center.)

The computer can now play 8:P-Q4, expecting P × P and finishing up with 9:N × P. From here the computer should be able to finish the exchange, which results in a strong position for white. The whole opening is shown in Table 2. (The memory dump is Program A.)

The advantage of this opening is that it leaves white with a strong position, even if the opening is not played all the way through. I haven't included a similar opening for black because such an opening has no real chance of succeeding. The reason for this is that white has the initiative in the opening, forcing black to simply make replies.

1:	P-K4	P-K4
2:	N-KB3	N-QB3
3:	B-N5	N-B3
4:	O-O	N × P
5:	P-Q4	B-K2
6:	Q-K2	N-Q3
7:	B × N	NP × B
8:	P × P	N-N2
9:	N-B3	. . .

Table 1.

1:	P-K4	P-K4
2:	N-KB3	N-QB3
3:	B-B4	N-B3
4:	O-O	N × P
5:	P-Q3	N-B3
6:	N-B3	B-B4
7:	B-K3	P-QN3
8:	P-Q4	P × P
9:	N × P	. . .

Table 2.

Program Modifications

With the opening out of the way, there was little left to glean from the programming manual. My next target was the program listing.

Near the end of the program (17C4 to 17E2) I found a bonus section similar to the one that involved the queen. In this case, the originating square and the destination square of a move are compared to prestored locations. If a match is found, a two point bonus is awarded.

The first part of the bonus checks to see if the piece is being moved from the back rank (squares 00 to 07). The second part compares the pieces' destination to four squares on the board. These squares are originally K4 (33), Q4 (34), KB3 (22) and QB3 (25).

These bonuses were originally included to help the computer through the opening stages of the game if the prestored opening were not played. The K4 and Q4 squares were intended for the king and queen pawns. The squares KB3 and QB3 were meant for the knights. Finally, the bonus for moving a back rank piece makes developing moves more attractive to the computer.

As far as the opening is concerned, these bonuses supply the computer with the guidelines it can follow. The problems begin to arise after the game has progressed a little further. These squares are no longer as important as they were in the beginning of the game.

I decided that different squares should receive the bonus. By changing the squares, I hoped to put the computer in a position where it could try to control the center. The simplest way to do this was to have the computer occupy the center.

The benefits of this are twofold. First, the center squares offer greater mobility for pieces posted there. Second, if a piece is in the center, it will probably be attacked. If this happens, it will have to be defended, thereby bringing more pieces to bear on the center.

To do this, I changed the bonus squares to K4, Q4, K5 and Q5 (33 at address 17C7, 34 at address 17CB, 43 at 17CF and 44 at 17D3).

I also changed the second bonus. Instead of awarding a move in the first rank, I decided to award moves in the first three ranks. This helps the computer post its pieces more offensively. To do this, simply replace the 10 at address 17DD with 30.

I have made two other changes in the program to increase the computer's awareness of the center. The first is quite simple. By increasing the value of the bonus section (at address 17E2) from 02 to 03, the availability of a bonus will have a greater influence on the move finally chosen.

The second change, a bit more involved, is to one of the lookup tables used by the computer when comparing moves. This table (from address 00A0 to 00AF) contains the "value" of the different pieces on the board. The original values are (decimal): king = 11, queen = 10, rook = 6, bishop = 4, knight = 4 and pawn = 2.

Because of the overriding importance of the king, I increased his value to 16. With the queen, I went in the opposite direction. Because the computer had a tendency to depend too heavily on this piece, I decreased its value to 9. I left the rooks and bishops unchanged. I didn't feel the knights should be worth as much as a bishop; therefore, I decreased their value to 3. I also devalued the pawns to 1.

There were two exceptions to this markdown. I chose to leave the king pawn and the queen pawn equal to two. This is another effort to focus the computer's attention on the center of the board. By making these pawns more valuable than the others, the computer will defend them more tenaciously, while attacking those of its opponent more fiercely (Program B).

That covers all of the changes I have made to date. By making these changes, you will be setting your computer to play a stronger level of chess. To guarantee that the computer is allowed to play its optimum game, don't try to play a serious game with the computer set to play at a blitz or superblitz level. ■

```
00C0  99 34 06 34 34 0E 56 23 05 45 25 07 53 24 0E 33
00D0  01 00 52 35 04 55 22 06 43 33 0F CC
```

Program A.

```
00A0  10 09 06 06 04 04 03 03 01 01 01 01 01 01 02 02
```

Program B.

Two Intriguing and Useful Apple II Peripherals

Getting to know Speechlab and Apple Clock.



Author's Apple system. Switches on the front select microphones, switch-off speaker and monitor. Key is the on/off switch for the entire system. Plug by the Apple logo is for game paddles. Large black button to the left of front microphone is the relocated RESET switch.

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For many months after its introduction, the Apple II computer was handicapped by its lack of peripherals. Since it used a nonstandard bus structure, the available S-100 or SS-50 bus devices would not work directly with it. Apple did (and still does) supply a hobby/prototyping card with complete bus documentation for $25, but this was little help to the non-hardware-oriented user (such as myself).

However, the wait is now over. Apple and several outside manufacturers produce a range of Apple II peripherals, which include parallel and serial interfaces, general-purpose communications cards, disk systems, ac-control systems, direct plug-in modems, digitizer tablets, etc. Also, there is a three-voice music synthesizer card and a light pen that connects to the video circuitry to provide automatic scanning.

This article deals with two of the more interesting Apple peripherals: the Apple Clock by Mountain Hardware and the Speechlab model 20-A by Heuristics, Inc. Both of these devices adhere to the Apple convention of "intelligent subsystems," i.e., all control software is contained on an on-card ROM and is called automatically. This has both advantages and drawbacks.

On one hand, it makes the devices extremely easy to use, even for the computer neophyte, but it also can limit the versatility and usefulness of the device, which can be a problem. Both devices come with excellent documentation and install merely by plugging into one of the seven available I/O slots on the main Apple board (slot #0, the left-most bus slot, is reserved for the Applesoft ROM card and cannot be used for anything else).

Heuristics Speechlab

This is certainly one of the more intriguing accessories for your computer—instant speech recognition! The manual that comes with the Speechlab is written with this "fascination factor" in mind, and contains several demonstration programs that the user is urged to type in and try out immediately; detailed operating instructions follow. These programs plot voiceprints on the screen in low-resolution graphics, play voice-input blackjack and recognize different speakers' given voice samples.

Using the Speechlab in your own programs is quite simple. There are three modes of operation: initialization, training and recognition.

Initialization. This consists of selecting the Speechlab for output and sending a PRINT to it. In practice, this would be

```
10 PR#(slot):PRINT:PR#0
```

where (slot) is the bus slot that the Speechlab board is in. This action clears the buffer table for Speechlab, which occupies memory from 2048 to 5500 decimal. It is thus necessary for LOMEM to be set at or above 5500 before using Speechlab. This may be done manually or incorporated directly into a program thus:

```
>NEW
>HIMEM:8192
>10 GOTO 5500
>POKE 8187,17
```

This procedure replaces the GOTO token in memory with LOMEM:, and upon listing the program the user will see:

```
10 LOMEM:5500
```

HIMEM may be reset after this is done.

Training. The model 20A can recognize up to 32 different entries. I use the term entries instead of words because, strictly speaking, the unit recognizes sounds up to 1.25 seconds in length, bounded by 0.1 second periods of silence. Thus, a phrase such as "room light on" may be stored as one table entry. However, if the user speaks slowly or pauses after a word, Speechlab will detect the afore-

```
100 PR#0:REM          SELECT VIDEO SCREEN FOR OUTPUT
110 PRINT "TEST":REM  PRINT 'TEST' ON SCREEN
120 PR#(slot):REM     SELECT SPEECHLAB FOR OUTPUT
130 PRINT "TEST":REM  SPEECHLAB WAITS FOR ENTRY AND ASSOCIATES IT WITH 'TEST'
```

Example 1.

mentioned 0.1 second of silence and assume the entry is terminated. Entries longer than 1.25 seconds are rejected with a beep of the Apple speaker, after which Speechlab waits for another input.

Training the Speechlab consists of printing a string to the unit. The unit will then wait for vocal entry, and this entry will be "associated" with the printed string. (See Example 1.) When this program hits line 130, it will stop. The next valid sound Speechlab hears will be put into the vocabulary table associated with the string TEST. There is no other relation between the string printed to Speechlab and the vocal input.

In practice, if you have less than 32 entries for any application, the unit is "multiple trained," i.e., the vocabulary table is filled with repetitions until full. In this fashion, the chance of Speechlab misunderstanding an entry is lowered. If, for example, you had a game program in which the inputs were to be the digits 0-9, the following section of code could be used for training:

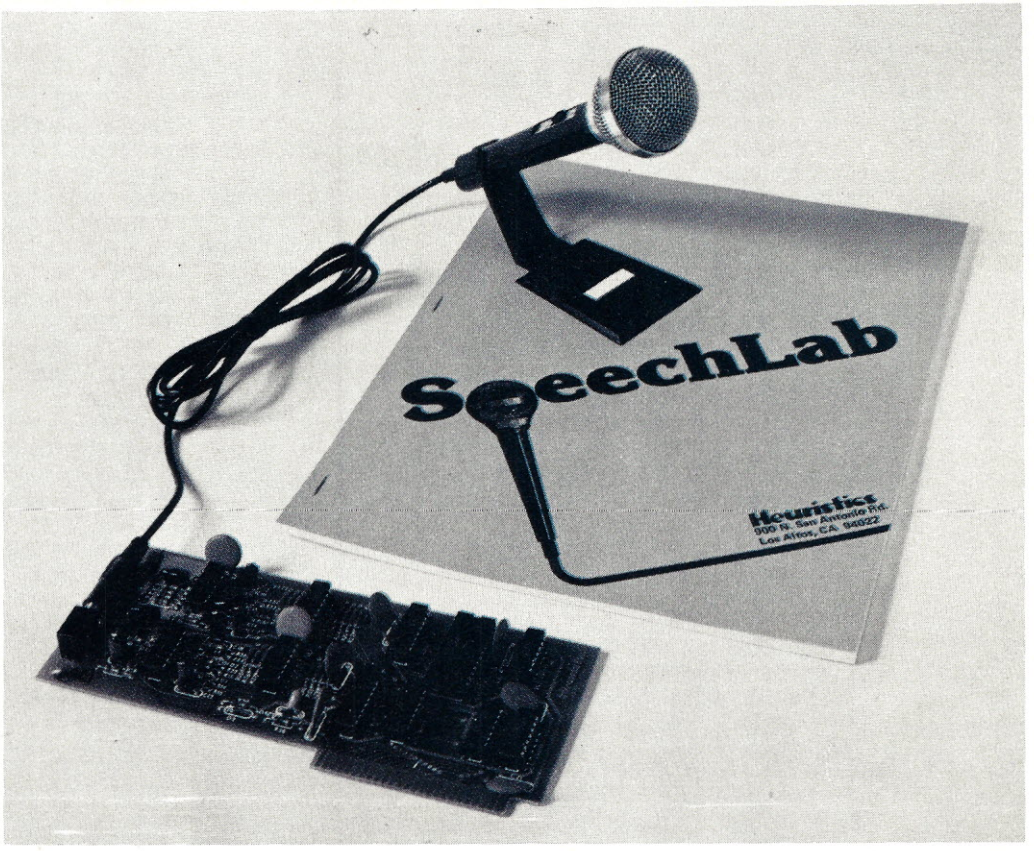
```
100 FOR Y = 1 TO 3:FOR X = 0 TO 9
110 PR#0:PRINT X:PR#(slot):PRINT X
120 NEXT X,Y
```

This sequence of code would print a digit on the screen and pause until a spoken entry was received. It would then print the next digit in the series. The sequence 0 through 9 would be repeated three times. This would take up to 30 of the 32 table entries available.

Recognition. Once the vocabulary tables have been entered, you can select Speechlab for input with a simple IN# (slot) statement. For example,

```
110 IN#(slot):INPUT A$:IN#0
```

would cause the program to pause until a spoken entry was received. The string that is associated with the sound in the training mode will be placed in A$. This is very convenient; it can also be used to make programs very confusing, as Speechlab, of course, doesn't care what string it associates an entry with. The unit can be trained to respond to "Hello" with GRXL if desired.



Heuristics Speechlab. *(Photo courtesy of Heuristics)*

Apple owners with the disk system are in great shape since the binary file save and load capability can be used to effectively make the vocabulary infinite! This disk can find and load a complete vocabulary table in less than five seconds. All that is necessary to save a table is for the user to enter:

```
BSAVE SPEECHTABLE,A2048,L3452
```

After initialization, the training period may be bypassed with

```
BLOAD SPEECHTABLE
```

This is useful if you are the primary user of your programs, since you do not have to retrain the unit to your voice every time. If there are multiple users of your programs, each can save a speech table under his name, and the program can load the correct one automatically after the user enters his or her name!

The Package

The Speechlab comes with a microphone, stand and the aforementioned user's manual. The microphone is a high-quality unit that works very well except in high-noise environments. If you must use Speechlab under these conditions, a noise-cancelling mike can be picked up at a local airport for about $60-$80. Private plane pilots use these types to enable themselves to be heard over the engine noise of small planes.

The manual is very well written. Numerous example programs are provided, as well as a complete description of the software and a circuit diagram and parts list for the actual board. There are sections explaining the speech-recognition algorithm (although no listing is given) and the hardware operation. I recommend reading these sections as they provide some very interesting information. For example, Speechlab normalizes all entries to time, so that the same word spoken at different rates of speed will have very similar entries built.

Applications

I am not too ashamed to say that I use my unit primarily for games and experiments. When I save enough to get an Introl ac controller system, however, I will expect all kinds of applications to open up! As a matter of fact, some Mountain Hardware Introl demo programs use the Speechlab to select devices for use. I envision a master control program that, upon hearing "lights," for example, will BLOAD the lights vocabulary table from the disk with a complete selection of commands for specific purposes.

Of course, there is great potential in uses for the handicapped, as well as any task that requires the use of your hands. I have seen Speechlab used to enter differential white blood cell counts. Instead of having to take his eye away from the microscope to make a tally mark by the proper type of WBC, the user merely spoke the name of the particular cell, and the Apple kept count automatically.

Since, to the Apple, input from the Speechlab looks just like keyboard input, the unit may be used in any instance where a program is controlled by the user. I have used the Speechlab for "remote" control

```
0  GOTO 15
1 H1 = (T > 53 OR T < 7) * 142 +
     (T > 6 AND T < 23) * 145 + (
     T > 22 AND T < 38) * 149 + (
     T > 37 AND T < 54) * 145:H2 =
     (T > 53 OR T < 7) * 149 + (T
      > 6 AND T < 23) * 145 + (T >
     22 AND T < 38) * 142 + (T >
     37 AND T < 54) * 145
2 V1 = (T > 53 OR T < 7) * 95 + (
     T > 6 AND T < 23) * 92 + (T >
     22 AND T < 38) * 95 + (T > 3
     7 AND T < 54) * 98:V2 = (T >
     53 OR T < 7) * 95 + (T > 6 AND
     T < 23) * 98 + (T > 22 AND T
      < 38) * 95 + (T > 37 AND T <
     54) * 92: RETURN
3  HCOLOR= 0: HPLOT CO%(0),CO%(1)
      TO CO%(2),CO%(3) TO A1%(M1,
     0),A1%(M1,1) TO CO%(0),CO%(1
     ): HCOLOR= 3: HPLOT A1%(M1,0
     ),A1%(M1,1): RETURN
4  HPLOT CO%(0),CO%(1) TO CO%(2),
     CO%(3) TO A1%(M,0),A1%(M,1) TO
     CO%(0),CO%(1): RETURN
5  HCOLOR= 0: HPLOT CO%(4),CO%(5)
      TO CO%(6),CO%(7) TO A1%(J +
     60,0),A1%(J + 60,1) TO CO%(4
     ),CO%(5): RETURN
6  HCOLOR= 3: HPLOT CO%(4),CO%(5)
      TO CO%(6),CO%(7) TO A1%(H +
     60,0),A1%(H + 60,1) TO CO%(4
     ),CO%(5): RETURN
15  DIM A%(59,1),A1%(119,1),CO%(7
     ):D$ =  CHR$ (4): TEXT : HOME
     : ONERR  GOTO 1000
16  FOR X = 49408 TO 50944 STEP 2
     56: IF ( PEEK (X) = 8) AND (
      PEEK (X + 1) = 120) AND ( PEEK
     (X + 2) = 44) THEN 18
17  NEXT : PRINT "NO CLOCK BOARD!
     ": STOP
18 CLOCK = (X - 49408) / 256 + 1:
      PRINT "CLOCK BOARD FOUND IN
      SLOT ";CLOCK: PRINT : PRINT
     "GENERATING CLOCK FACE CO-OR
     DINATES..."
20 C = 0: FOR I = 3.14159 TO  - 3
     .14159 STEP  - 0.10472:XC0 =
     145 + 75 *  SIN (I):YC0 = 75
      *  COS (I):A1%(C,0) = XC0:A
     1%(C,1) = YC0 + 95:C = C + 1
     : NEXT
40 C = 60: FOR I = 3.14159 TO  -
     3.14159 STEP  - 0.10472:XC0 =
     145 + 45 *  SIN (I):YC0 = 45
      *  COS (I):A1%(C,0) = XC0:A
     1%(C,1) = YC0 + 95:C = C + 1
     : NEXT
50  HGR : POKE  - 16302,0: PRINT
     "BLOAD CLOCK FACE 2"
55 T$ = "              ":S$ = T$:H =
     0:M = 0:S = 0
60  PRINT D$;"PR#";CLOCK: PRINT D
     $;"IN#";CLOCK
500 X =  FRE (0): INPUT " ";T$: IF
      MID$ (T$,14,1) =  MID$ (S$,
     14,1) THEN 500
501  IF  PEEK ( - 16384) = 155 THEN
      PRINT "PR#0": PRINT "IN#0":
      TEXT : HOME : POKE  - 16368
     ,0: END
505 H =  VAL ( MID$ (T$,7,2)):M =
      VAL ( MID$ (T$,10,2)):S =  VAL
     ( MID$ (T$,13,2)):S$ = T$: IF
     H > 12 THEN H = H - 12
510 H = H * 5 +  INT (M / 12): IF
     H >  = 60 THEN H = H - 60
515 T = S - 1: IF T < 0 THEN T =
     59
516  HCOLOR= 0: HPLOT 145,95 TO A
     1%(T,0),A1%(T,1): HCOLOR= 3:
      HPLOT A1%(T,0),A1%(T,1): HPLOT
     145,95 TO A1%(S,0),A1%(S,1)
517  FOR X = 91 TO 99: HPLOT 142,
     X TO 149,X: NEXT
520  IF  NOT F1 THEN 526
521  IF M1 = M THEN  GOSUB 4: GOTO
     530
525  GOSUB 3
526 T = M: GOSUB 1:CO%(0) = H1:CO
     %(1) = V1:CO%(2) = H2:CO%(3)
      = V2: GOSUB 4:M1 = M:F1 = 1

530  IF  NOT F2 THEN 545
535  IF H = J THEN  GOSUB 6: GOTO
     500
540  GOSUB 5
545 T = H: GOSUB 1:CO%(4) = H1:CO
     %(5) = V1:CO%(6) = H2:CO%(7)
      = V2:J = H:F2 = 1: GOTO 500

1000  PRINT D$;"PR#0": PRINT D$;"
     IN#0": TEXT : PRINT : PRINT
      PEEK (222);" ERROR AT LINE
     "; PEEK (218) +  PEEK (219) *
     256
9000  REM  JAN 1979 BY DAVID RAMS
     EY NOTE: DUE TO MINOR DIFFER
     ENCES IN HPLOT COMMANDS IN R
     AM AND ROM APPLESOFT, WILL N
     OT WORK DIRECTLY WITH RAM AP
     PLESOFT. STATEMENTS 3-6 MUST
      BE CHANGED.
```

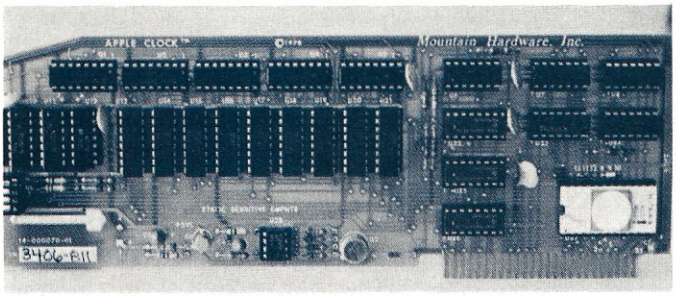
Listing 1. Analog Clock program. Written in Applesoft II BASIC.

of the Apple when giving demonstrations of the machine. In these cases, it was plugged into a 25 inch monitor facing the audience, and I could point to the screen and control the demonstration without having to run around to the Apple keyboard.

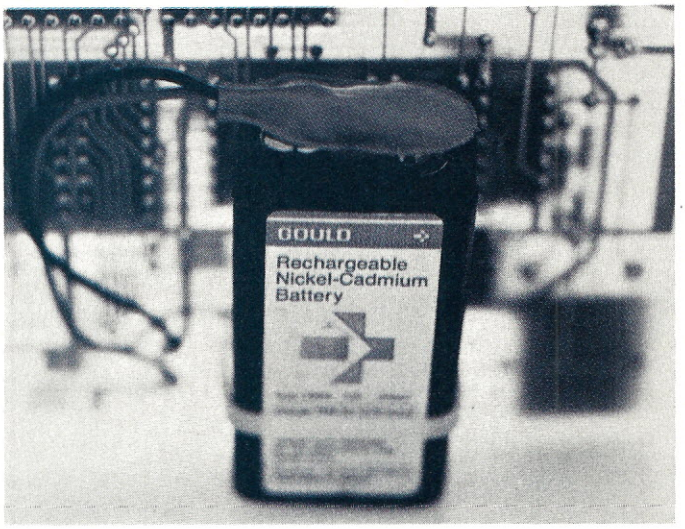
Some Weaknesses

The ROM software, as previously mentioned, limits the use of the device. For example, if the Speechlab cannot find a good match, it will return an empty string. Apparently, there is some sort of "fudge factor" that must be exceeded for this to occur. Well, the unit will do its best to find an entry for what you said; in most cases, you will get something back if you burp into the mike. I have used my unit for five months now and have gotten an empty string back maybe three times. It would be nice to be able to alter this fudge factor.

A more serious limitation is the fixed location of the vocabulary table. As some readers may have surmised, this makes it impossible to use with either the RAM or ROM version of Applesoft II. I have tried some of the relocation schemes floating around to tell Applesoft to keep out of that area of memory, but I have yet to be able to make it work! I queried Heuristics, which didn't know how, either, but the company is working on the problem. It would be nice if the user could specify the location of the vocabulary table to suit his needs. Perhaps in the future an



Mountain Hardware Apple Clock. ROM is at lower right; binary dividers are to the left center.



Rechargeable nicad 9 V cell on Apple Clock board.

upgraded ROM will be made available that will enable present users to switch their ROMs for an improved version of the software.

The Speechlab is priced at $189. Perhaps, at that price, I should really have no complaints (at the 1977 NCC in Dallas I saw a much larger separate unit with a 16-word vocabulary selling for $3000!). You could ask Bell Labs what they want for one of their voice-recognition systems . . . and what they will tell you should convince you that the Speechlab is one of the great hardware bargains currently extant.

Mountain Hardware Apple Clock

If the Speechlab is intriguing, the Apple Clock is *useful*. It has all sorts of practical value that can be exploited once it is installed. Physically, it is a large circuit board whose leading edge is chamfered to fit under the downward slope of the standard Apple case. The board contains a 9 V nicad battery that is trickle-charged and can retain the correct time for up to 4 days with no power to the Apple. You can even remove the board and carry it around without its missing a second!

The board provides the date and time in a 24 hour format. Resolution of the time is to the millisecond. Like the Speechlab, the Apple Clock returns its data as a string. It is selected for input and read from a program by the following sequence:

```
110 IN#(slot): PR#(slot): INPUT " ";T$: IN#
    0: PR#0
```

After this statement, the time is in T$. An example of what the user would find in T$ could be:

```
03/20 23;34;17.434
```

which indicates March 20th, 23 hours, 34 minutes, 17.434 seconds.

The manual gives instructions on how to make a "quick read" of the clock board. All that is necessary is to enter

```
IN# (slot)
```

from either integer BASIC or Applesoft. However, this is of limited use at best since it provides a continuous readout of time as fast as the Apple can print it. RESET must be pressed to halt. In integer BASIC the following annoying sequence is generated:

```
>03/20 23;34;17.434
 (beep)***SYNTAX ERR
>03/20 23;34;17.988
 (beep)***SYNTAX ERR
>03/20 23;34;18.233
 (beep)***SYNTAX ERR etc.
```

Applesoft gives the same multiple readout, but does not respond with the SYNTAX ERR message.

The manual included with the clock board is perhaps the best documentation I have ever seen provided with any computer product. For example, sample programs that print out the time are given for integer BASIC, integer BASIC with DOS, Applesoft and Applesoft with DOS. Instructions are provided for both BASICs to extract any desired portion of the time string, i.e., hours, seconds, month, etc. These programs are given to provide the time in either the board's 24 hour format or a 12 hour AM/PM format.

A useful program is given to measure elapsed time. The time at the start of an event is read in as T1$, the time at the end of an event is read in as T2$, and the times are then converted to seconds and subtracted. This is very useful. It can be used to time sections of a program, for example. If you have a long or complex program that runs for hours, this feature can give you the end time and elapsed time to the millisecond!

I have written a Hello program, resident on all of my disks, that upon booting provides the following display:

```
GOOD MORNING, AFTERNOON,
   EVENING)
IT'S (hh:mm) ON (JAN . . . DEC) (dd)
LAST DISK BOOT ON (JAN . . . DEC) (dd)
   AT (hh:mm)
```

This program is shown in Listing 1. It requires a data file, TIMEFILE, to be resident on the disk; the brief program in Listing 2 will create and initialize such a file.

The clock board has another powerful capability—it generates interrupts on one-second intervals when the interrupt lines are enabled. It is necessary to delve into machine language to make full use of this feature. When the board interrupts, the Apple will perform a jump to the address contained in memory bytes 3FE (low) and 3FF (high).

From either BASIC or machine language, the user can start the clock, stop the clock, read the month, date, hours, minutes, seconds and tenths, hundredths and thousandths of seconds individually. From assembly language, a JMP CN00, where N is the number of the slot the clock board is in, will return the full-time string in locations 0280 (hex) to 02A1.

The manual includes sections on theory of operation, with hardware, ROM access, interrupts, regulator circuit and

```
10 D$="": DIM T$(18)
20 PRINT D$;"IN#5": PRINT D$;"PR#5"

30 INPUT " ",T$
40 PRINT D$;"IN#0": PRINT D$;"PR#0"

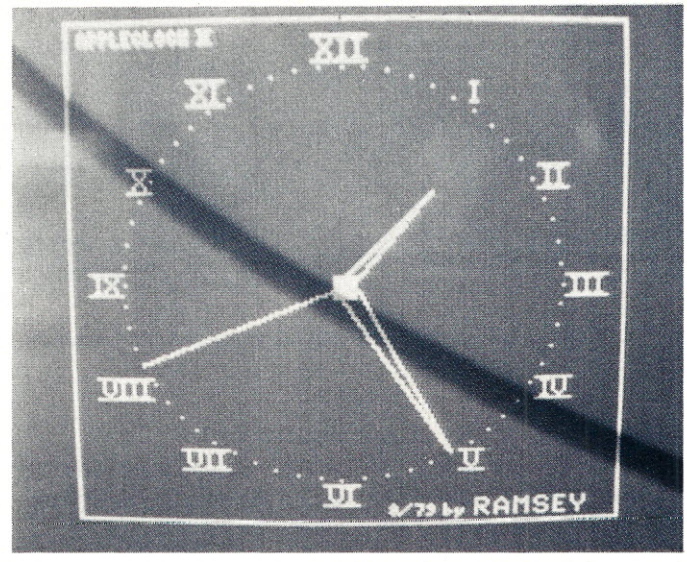
50 PRINT D$;"OPEN TIMEFILE,D1"
   : PRINT D$;"WRITE TIMEFILE"
   : PRINT T$: PRINT D$;"CLOSE TIME
   FILE": PRINT D$;"LOCK TIMEFILE"

60 END
```

Listing 2. Sets up a TIMEFILE for use with the Analog Clock program. Written in integer BASIC. Line 10 shows D$ = " ", which sets D$ to control-D. The user must enter a control-D character between the quotes.

```
10 D$="": REM     D$ = CONTROL-D
20 PRINT D$;"NOMON I,C,O"
30 DIM A$(108),T$(18),T1$(18)
40 A$="JANUARY  FEBRUARY MARCH    A
   PRIL    MAY      JUNE     JULY
      AUGUST   SEPTEMBEROCTOBER  NO
   VEMBER DECEMBER "
50 TEXT : POKE -16300,0: CALL
   -936
55 FOR X=-16128 TO -14592 STEP
   256: IF ( PEEK (X)=8) AND (
    PEEK (X+1)=120) AND ( PEEK
   (X+2)=44) THEN 57
56 NEXT X: GOTO 180
57 SLOT=(X+16128)/256+1
60 PRINT D$;"IN#";SLOT: PRINT
   D$;"PR#";SLOT: INPUT " ",T$
   : PRINT D$;"IN#0": PRINT D$
   ;"PR#0"
70 M= ASC(T$(1))-176:M=M*10+( ASC(
   T$(2))-176):D= ASC(T$(4))-176
   :D=D*10+( ASC(T$(5))-176):H=
    ASC(T$(7))-176:H=H*10+( ASC(
   T$(8))-176)
80 PRINT "GOOD ";: IF H>=0 AND
   H<12 THEN PRINT "MORNING.":
    IF H>11 AND H<18 THEN PRINT
   "AFTERNOON.": IF H>17 THEN
   PRINT "EVENING."
90 PRINT "IT'S ";T$(7,8);":";T$
   (10,11);" ON ";:C=0
100 IF A$(M*9-8+C,M*9-8+C)=" " THEN
    110: PRINT A$(M*9-8+C,M*9-8
   +C);:C=C+1: IF C=9 THEN 110
   : GOTO 100
110 PRINT " ";D;", 1979"
120 PRINT D$;"READ TIMEFILE": INPUT
   T1$
130 M= ASC(T1$(1))-176:M=M*10+(
    ASC(T1$(2))-176): PRINT "LAST D
   ISK BOOT ON ";:C=0
140 IF A$(M*9-8+C,M*9-8+C)=" " THEN
    150: PRINT A$(M*9-8+C,M*9-8
   +C);:C=C+1: IF C=9 THEN 150
   : GOTO 140
150 PRINT " ";T1$(4,5);" AT ";T1$
   (7,8);":";T1$(10,11)
160 PRINT D$;"UNLOCK TIMEFILE":
    PRINT D$;"WRITE TIMEFILE":
    PRINT T$: PRINT D$;"CLOSE TIMEF
   ILE"
170 PRINT D$;"LOCK TIMEFILE": PRINT
   : PRINT D$;"CATALOG"
180 NEW : END
```

Listing 3. Hello program in integer BASIC.



Apple Clock (Analog) produced by Listing 3 in conjunction with the Apple Clock board. Version shown here also has "clock face" HIRES binary file; Listing 3 will reproduce only the hands and second ticks.

software. As with the Speechlab, a full parts list and circuit diagram are supplied. The manual also contains instructions on setting the frequency and replacing the 2708 ROM with a user-supplied 2716 PROM. This is excellent for those with the knowledge who wish to change some of the clock software.

Minor Nitpicks

The Apple clock is not a 100,000 day clock like its S-100 "big brother." This means the user must reset it at least once a year before Jan. 20. A DIP switch on the board selects whether it is a leap year or not. This switch can be queried from BASIC with the proper PEEK command.

I would like the "quick read" software to be modified to print the time *once* and return control to the Apple. I would also like to be able to specify the time between interrupts. Perhaps these last two complaints could be corrected with a new PROM.

As with the Speechlab, the full utility of this device awaits its marriage to an ac controller system.

I have written the Analog Clock program, a good idler and demonstration program (see Listing 3). This puts a real-time analog clock on the HIRES screen, with hour, minute and second hands. My version BLOADs a binary file "clock face" to provide a face for the clock—but there is no easy way to distribute an 8K memory dump in magazine format. Even if it were printed, would you want to enter it by hand?

Program Notes

If you are using RAM Applesoft, two changes must be made. The HGR command must be changed to HGR2, lest Applesoft clobber itself. This requires that you have at least 24K of memory (36K with a disk system).

Also, ROM Applesoft lets HPLOT commands be chained together, such as HPLOT X,Y TO X1,Y1 TO X2,Y2, TO (ad infinitum). However, the disk RAM Applesoft does not permit this, so that the above statement would have to be broken up into HPLOT X,Y TO X1,Y1:HPLOT to X2,Y2:HPLOT TO, etc. The HPLOT commands in the program must be changed accordingly if your are using RAM Applesoft.

Peripheral Use with the Apple DOS

The Apple DOS has its little quirks. One of the more annoying is that any reference to a peripheral slot must be PRINTed like any other DOS command. This can get rather tiresome, since a simple PR#4 is transformed into PRINT D$;"PR#4". If the simpler command is used, it will break contact with the DOS.

I have recently found a way around this: After using the standard I/O reference commands, all that is necessary is to CALL the DOS. The location you need to call may be found by this statement:

```
PRINT PEEK(977) + PEEK(978)*256
```

or by subtracting 8769 from the amount of memory in your system. For example, a 36K system has 36864 bytes of memory (1023*36), and this number minus 8769 gives 28095.

The last statement in your program would be a CALL to this point. This restarts the DOS and halts your program as though it had hit an END statement. In practice, it is a good idea to set a variable DOS with the PEEK statements as shown above, and then perform a CALL DOS. This ensures that your program will work on systems with different memory sizes. ■

Author's note: Heuristics has announced an upgraded version of Speechlab (now called Speechlink) for the Apple. At $260, it has these improvements:

- Mountain Hardware no longer produces the old Introl unit, but now has the improved, less expensive Introl X-10 based system. In conjunction with the Apple Clock, this system offers complete foreground/background operation.
- Multiple 64-word vocabularies in memory at user's choice of location.
- User-settable rejection factor.
- Works with both BASICs and PASCAL.

The model 20a will still be produced.

EXATRON STRINGY FLOPPY
Owners Association Newsletter

Secretary, Fred Waters

THE STRINGY FLOPPY

Are you completely satisfied with your cassette recorder as a mass storage device for your microcomputer? IF NOT, READ ON. Do you now have a way to save the programs you write, and the data files that go with the programs, so you can load them into memory quickly and accurately? IF NOT, READ ON. Have you decided that you must have a disk system for your microcomputer, regardless of the cost? IF NOT, READ ON.

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If you haven't heard of us before now, get a quick look by reading our newsletter in back issues, starting last August (this is our 7th newsletter). Call us on the Hot Line below for the complete information packet. Stringy Floppys are available for the TRS-80, S-100 bus micros, and SS-50 systems.

THE WORKSHOP SYSTEM

There are now ESFs all over the U.S., and quite a few in Europe, the Far East and Australia. In population centers there may be many owners who are not yet aware of their fellow owners nearby. Here in the Santa Clara Valley, where the ESF was created, we have long experience in the value of owners with common interests getting together for their mutual benefit. The ESFOA Saturday morning workshop—hasn't missed since January 1978!—is a permanent institution, and we knew others would benefit the same way. So in November, as part of a continuing program of keeping all registered ESF owners completely up to date, information was sent out to all current owners on setting up local ESF Workshops wherever they are wanted. Local chairmen are being designated, and are furnished with mailing lists and telephone numbers of other local owners. Their names are used as contact points for non-owners who want to find out locally about the Stringy Floppy. There are certain specific benefits for the chairmen, and of course general benefits for all who participate.

Once you have your own Stringy Floppy, you profit not only from the material and practical advantages of this remarkable subsystem, but also from the more intangible benefits of cooperation in all fields with other ESF owners. You don't just acquire a very useful piece of hardware for your micro—you also pick up an option to participate, at whatever level and to whatever degree you choose, in a large group with common aims. And this idea REALLY WORKS!

HELPS AND HINTS

As all you micro owners have found out, every time a group of you gets together, several useful programs, or programming techniques, or HELPS AND HINTS are passed around. Here in Silicon Gulch we are lucky in having a higher than usual share of professional programmers who leave their big machines at the end of the working day, and go home to become creative on their small machine. And we have a lot of very talented amateurs too. So part of ESFOA's continuing liaison with all current ESF owners is the distribution of "Helps And Hints – An Insiders Newsletter". This is distributed to Workshop Program Chairmen for dissemination to workshop participants. One more benefit of ESF ownership and ESFOA membership.



Linda Howell is the gentle voice you hear when you call the Exatron Hot Line for an information packet, or for answers to questions about the ESF. Linda just received her degree in accounting from San Jose State, and is in charge of sales and customer relations. She operates the Stringy Floppy, too!

And don't let that word "membership" throw you. All owners are automatically members, with no dues, no requirements, no qualifications—just benefits.

ESF SOFTWARE

Good hardware stimulates the demand for good software. If you've been following our newsletter, you read in November about superb systems programs written specially for the S-100 ESF, in December about the ESF-80 Monitor for the TRS-80 ESF, and in January about the splendid Data I/O Program for the TRS-80 ESF. It just keeps coming! A very significant point about all of these programs, and most others, is that they are written to meet specific needs or demands by individuals. The input surfaces when users get together and exchange ideas and techniques, and somehow there is always some able person who accepts the challenge and creates the program.

Another kind of demand for software also exists. ESF owners are often enthusiastic users of commercial software available on other media, and need software mods for Stringy Floppy, or simply need the program on ESF wafer, or both.

Well, there's quite a bit being done to meet both of these types of demand. Exatron has made specific arrangements with Michael Shrayer to have the ESF interface programmed into the Electric Pencil for the TRS-80, and to market the interface along with the standard Electric Pencil package. If you've already used this excellent word processing program, nuff said. If you haven't, ask around. It can't be touched for price and quality. This newsletter has been composed since its inception with the Electric Pencil.

Have you heard of PIMS, Scelbi Publications' Personal Information Management System? Enough of a demand for this program existed here in the Santa Clara Valley that Exatron made arrangements with the publisher to market their book, along with the program on ESF wafer. This is a real bargain.

HOW TO ORDER

The ESF is assembled and tested at the factory, with a 30-day moneyback guarantee and a one-year full warranty, and is normally in stock and ready to ship. For the fastest delivery, phone in your credit card or COD order, using the toll-free line below.

Base price for the TRS-80 ESF is $249.50 (ask about the Starter Kit); for the S-100 ESF, $289.50; for the SS-50 ESF, $250.00. The 2-for-1 Bus Extender is $15.00; the ESF-80 Monitor is $9.95. Users manuals for all versions of the ESF and complete information packets are available at no charge.

If you have any questions about the product, about Exatron, or ESFOA, please call the Hot Line. Address letters to ESFOA, 3559 Ryder St., Santa Clara, CA 95051

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The Elf EPROMmer

Got the Giant Board? Then an EPROM programmer is easy.

If you bought the Giant Board and the 4K memory board for your Elf II, then you can build a simple EPROM programmer with only a few inexpensive ICs, transistors and resistors. Then you can store all those home-made programs, your own monitor system or Tiny BASIC; and your computer will be ready to run your programs as soon as the power switch is turned on.

The Giant Board makes it easy since it contains a latched output port that can be connected to your programmer and a ROM monitor system for accessing the programs you will write onto your EPROM. The 4K board is necessary to provide an area to load your program for copying.

Also, it provides latched and buffered high-order address bits you will need to address the 1K EPROM memory and for selecting between EPROMs. The high-order bits can be brought down to unused pins on your 88-pin bus, so that you can conveniently build your programmer on a board that plugs directly into the Elf bus.

The EPROM programmer described here uses two EPROM sockets: one for programming and one for reading. In the programming mode, the EPROM is treated as an output device; while in the reading mode it becomes a randomly accessible memory. The advantage of this approach is that the READ socket can be used not only to verify that a program has been loaded correctly, but also to run the programs stored on your EPROM.

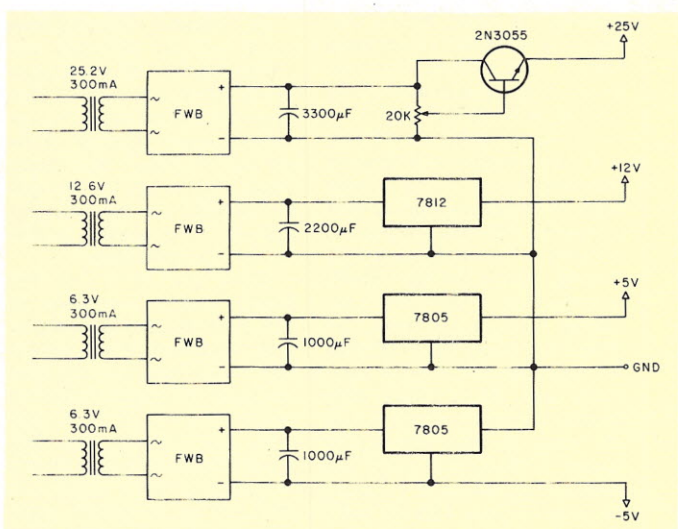


Fig. 2. Power supply schematic.

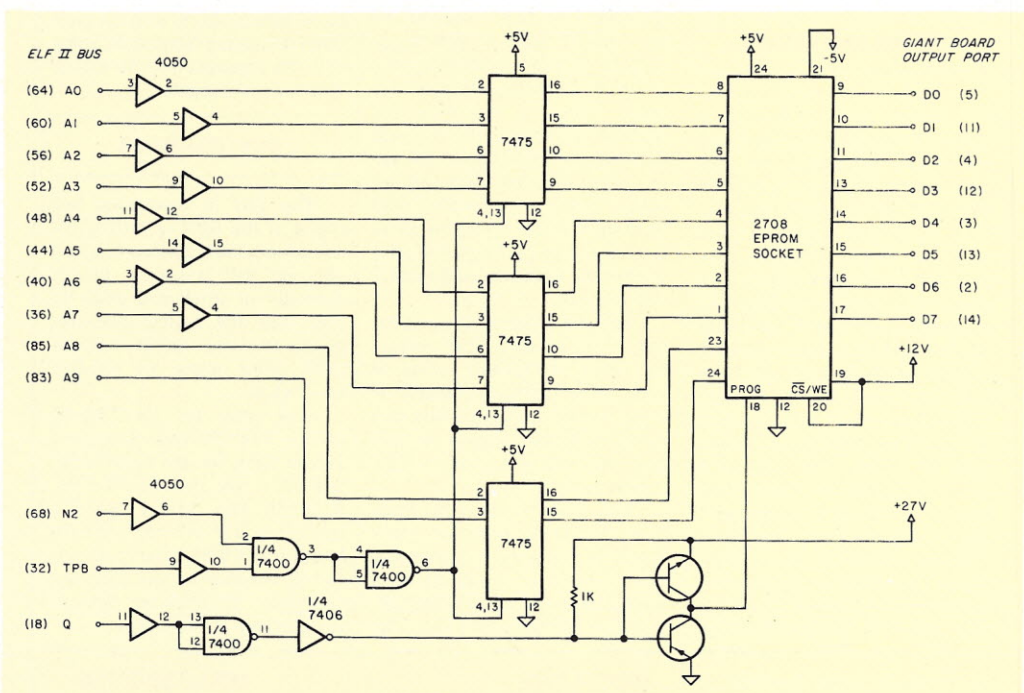


Fig. 1. EPROM programming circuit.

Programming the 2708 EPROM

Fig. 1 shows a schematic of the programming circuit. The address lines (A0 to A9), the timing pulse (TPB), the I/O select line (N2) and Q come directly from the Elf bus. The pin connections are shown in parentheses. The data lines (D0 to D7) are available on the Giant Board on a 14-pin DIP socket.

If a similar socket is mounted on the programmer, then a 14-pin ribbon cable connector can be used to connect this out-

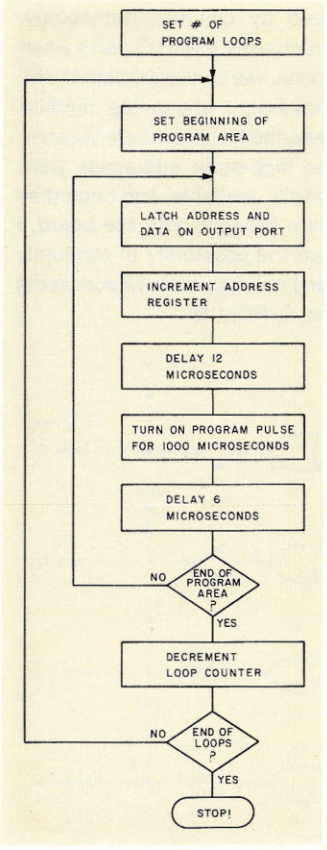


Fig. 3. Program loop flowchart.

put port to your circuit. Other connections include ±5 V, +12 V and 27 V. A power supply that provides these voltages is shown in Fig. 2.

How It Works

In the programming mode, chip select/write enable ($\overline{CS}$/WE) is held high at +12 volts by direct connection to the 12 volt supply. (This is pin 20 on the 2708 EPROM socket.) Addresses are placed sequentially (from 000 to 3FF) onto the EPROM whenever N2 and TPB are high. A 67 output instruction is used to raise N2. The 7475 four-bit latch latches its outputs as the enable pulse at pins 4 and 13 falls. Therefore, N2 must be ANDed with TPB so that this pulse goes low when correct addresses are presented to the 2708.

The 67 instruction was chosen since this also controls the output port on the Giant Board. This instruction, therefore, loads and latches the correct data bits onto the EPROM at the same time as the address bits.

Twelve microseconds after a particular address and data have been latched onto the 2708, the Q line goes high and turns on the 27 volt program pulse to write the data at that location. A timing loop holds this pulse on for 1 millisecond. When the program pulse goes low, the next address and new data are placed on the EPROM and the sequence is repeated for all 1024 locations. When all locations have been written once, this defines a program loop, which must be repeated 100 times to ensure that the data has been correctly written in. A flowchart demonstrating this sequence of events is shown in Fig. 3.

Program A shows the hexadecimal listing for programming the 2708 EPROM. In step 2, note that the area to be copied is located from 0400 to 07FF. If you wish to use this program to copy a different 1K area, then the starting address, 0400, can be changed, as long as the bottom ten bits of this address are all 0s.

location	bytes	steps	comments
00	F8 6A A1	1	set programming loop counter
03	F8 04 B2	2	set beginning address of
06	F8 00 A2		area to be copied
09	E2	3	M(R2) = MX
0A	67	4	latch DATA and ADDRESS onto output port; R2 + 1
0B	C4 C4	5	delay
0D	7B	6	turn on program pulse
0E	F8 3B A3	7	load 3B into register 3
11	23	8	R3 − 1
12	83	9	R3.0 → D
13	3A 11	10	GO TO 11 if D ≠ 00
15	7A	11	turn off program pulse
16	C4	12	delay
17	92	13	R2.1 → D
18	FB 08	14	R2.1 × OR 08
1A	3A 0A	15	GO TO 0D if D ≠ 00
1C	21	16	R1 − 1
1D	81	17	R1.0 → D
1E	3A 03	18	GO TO 03 if D ≠ 00
20	00	19	STOP!

Program A. Hex listing for programming the 2708 EPROM.

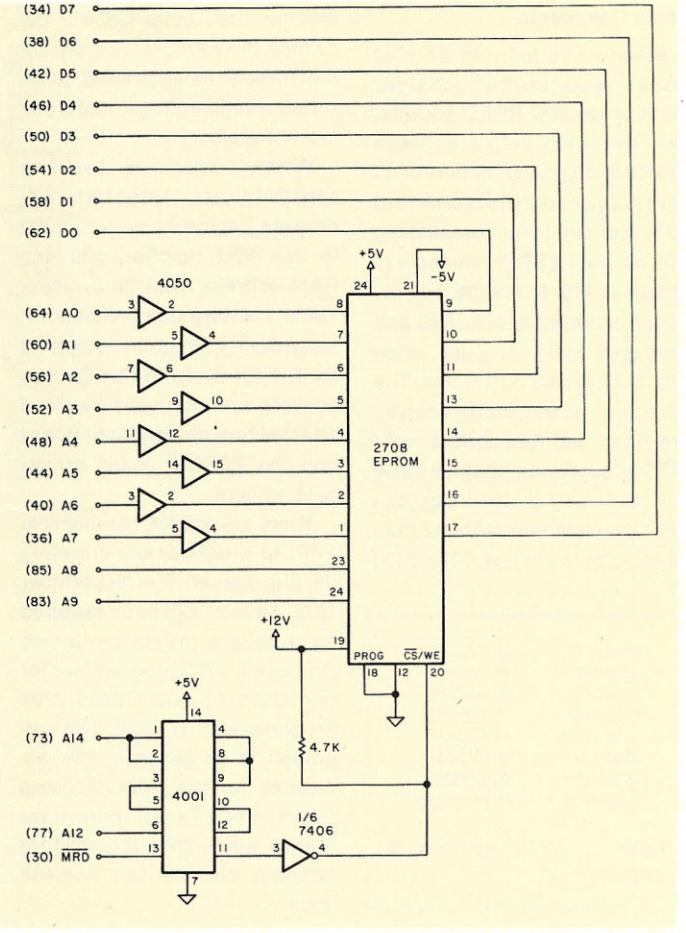


Fig. 4. Circuit modification.

Also, when the 2708 is erased, it contains 1s in all locations. Therefore, if you are not copying all 1024 locations, the remaining spaces should be filled up with FFs, so that you can add other programs later. For example, I entered my programming program into locations 0400 to 0420, filled locations 0421 to 07FF with FFs and now have an EPROM that will program other EPROMs. Having the two separate sockets makes this possible.

Verifying and Using Your EPROM

By adding one more IC and a new socket to your board, you can verify your program or use your EPROM as a read-only memory. The schematic is shown in Fig. 4. (Address lines A0 to A7 use the same buffers as in Fig. 1.) In this socket, the PROGRAM pin is grounded and $\overline{CS}$/WE is pulled low by A14, $\overline{A12}$ and MREAD. This makes its location 4000 to 43FF. The 2708 data outputs can be connected directly to the Elf bus, since these outputs are Tri-state.

You can verify that the program has been loaded correctly by using the Elf's monitor on the Giant Board. Load the program, C0 F0 00, to get into the monitor. Press the RUN switch and load 01 40 00 to examine the memory starting at location 4000. Each time you press and release the input switch you will alternately observe the low-order address bits and the data bytes on the hex display. If the first dozen or so bytes are correct, then you have most likely made a correct copy, and you should then try to run the EPROM programs.

To run a program starting at the first location, load C0 40 00 and press the RUN switch. You can run a program at any other location by loading C0 and the correct address from 4000 to 43FF.

Some Comments

When you build your EPROM board, you might consider building several READ sockets. You can then select between EPROMs by decoding part or all of the upper address bits (A10 to A15). A circuit for accomplishing this for a 4K EPROM memory is shown in Fig. 5. The 74C154 decoder decodes A10 to A13 and produces valid outputs when A14 is high and A15 is low. The selected outputs themselves are low and are gated with $\overline{MRD}$ to produce a positive pulse for selecting the correct EPROM. Only four of the 16 possible outputs are used. The 7406 inverter then pulls $\overline{CS}$/WE low to read the EPROM. This particular inverter must be used, since it has a high voltage, open collector output.

When locations for the EPROMs are selected, addresses beginning with F (F000 is the ROM monitor) and any RAM address must be avoided. Table 1 shows one possible arrangement of memory locations for the Elf II, if the five Elf bus sockets are occupied by three 4K RAM boards, the Giant Board and the EPROM board as described here.

There are several inexpensive EPROM programmers currently on the market. The September 1978 issue of *Kilobaud* features an excellent article by James Grina on a 2708 programmer for the KIM-1 ("Super Cheap 2708 Programmer," p. 100). His approach is to generate the addresses for the EPROM using three 4-bit 74193 counters, thereby eliminating the need for bringing out the ten address lines.

0000-0FFF	4K RAM #1
1000-1FFF	4K RAM #2
2000-2FFF	4K RAM #3
4000-43FF	1K EPROM
4400-47FF	1K EPROM
4800-4BFF	1K EPROM
4C00-4FFF	1K EPROM
F000-F0FF	ROM monitor

Table 1. Elf II memory allocation.

In order to use this circuit on the Elf II, another output port (in addition to the input and output ports available on the Giant Board) has to be constructed. This port would be used to produce the program pulse, set the $\overline{CS}$/WE state and increment and reset the counters.

This approach is also used by an EPROM programmer developed by Optimal Technology, which uses three I/O ports when connected to the COSMAC VIP. However, I chose the method described in this article because the high-order addresses were readily available, and once they were brought onto the board, I had the possibility of randomly (and not sequentially) accessing the EPROM. ■

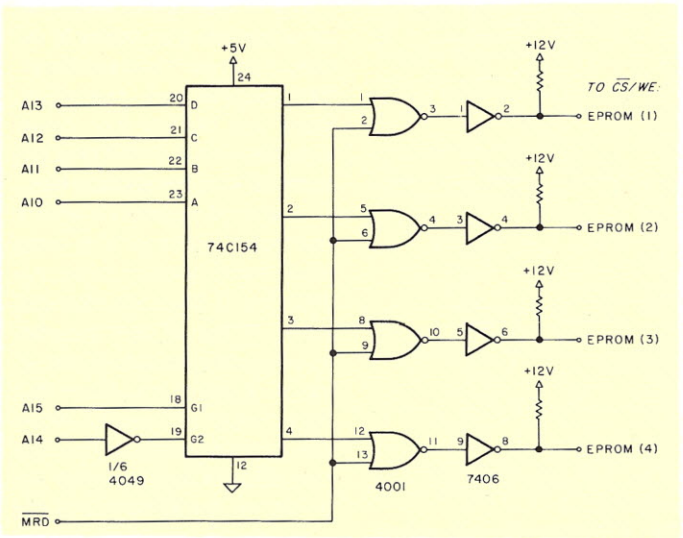


Fig. 5. 74C154 decoder circuit.

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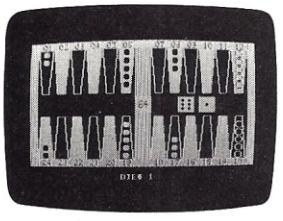
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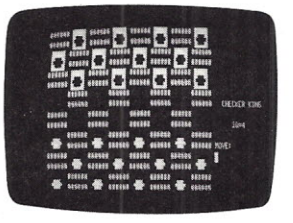
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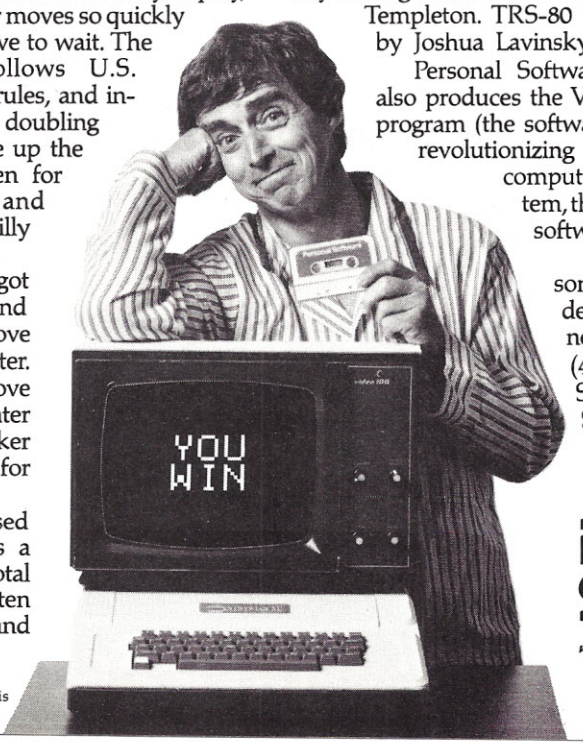
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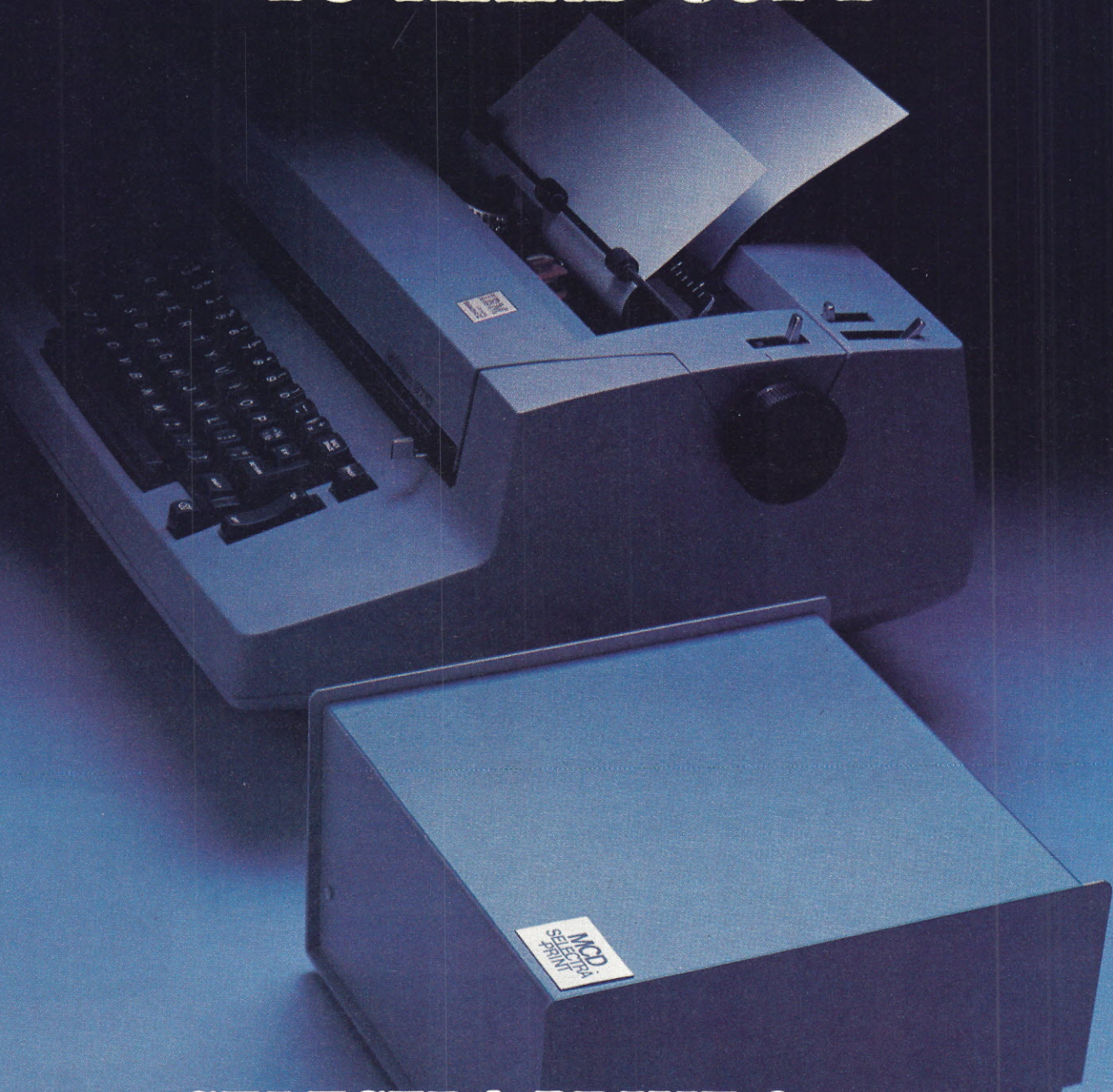
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✓ Reader Service index—page 241

Thoughts on the SWTP Computer System

Part 9 covers three areas: disk systems, debugging and EPROM conversions.

Peter A. Stark
PO Box 209
Mt. Kisco NY 10549

This month we will talk some more about disk operating systems, fixing some BASIC bugs and converting the SWTP MP-R 2716 EPROM programmer to work with 2708 EPROMs.

Disk Operating Systems

Since our discussion in this series on mini-floppy disk systems, I have come across more aspects of the situation; my solutions may be useful to others.

I have a dual drive Percom system that I use almost daily. But we have at the office two systems with SWTP disk systems operating under the FLEX operating system. Some time ago I decided it would be worthwhile to have a compatible system in my home office too.

At just about that time, Peripheral Technology Associates (PTA), 3848 Hampton Dr., Columbus GA 31904, announced a compatible disk controller card which I purchased and built for about $90. I got a cabinet and power supply from Percom for about $80 and a Wangco drive from Heath (their H17-1 add-on drive for the H17 disk system) and had a single drive system running FLEX for under $500. (It could have been a lot cheaper if I had built my own cabinet and power supply.) I wouldn't be surprised if there are others who will take the same approach.

The Percom system has its entire DOS in ROM (and latest Percom ads indicate that their system is now supplied with MINIDOS-PLUSX, rather than the more spartan MINIDOS). Hence, this system can be used with even blank disks. Utilities that save, load, delete or rename files, initialize the disk and list the directory are in the ROM. You can take a blank disk straight out of the box and immediately start using it.

But using FLEX with a single disk drive is downright painful . . . there's a good reason why SWTP doesn't even offer the disk system with just one drive. The utilities to initialize a new disk, save a file on the disk, print out the directory, rename or delete files are themselves disk files that must be in the drive when you use them. Aside from the fact that they take up disk space, a more important problem is how to get them on a blank disk to begin with if you only have a single drive system. (Incidentally, this dicussion is devoted to the so-called mini-FLEX version, not to the newer FLEXes.)

The situation is compounded by another factor. These utilities are written so that they need to be given their parameters when they are called. As soon as this is done, they are fetched off the disk and executed. In most cases, there isn't any pause during which you can pull out the disk they were fetched from and substitute the disk you want them to work on. Fortunately, PTA supplies patches to the SAVE and CAT utilities to allow saving on and printing the directory of disks that do not have these commands on them.

But there are some other tricks we can use. To illustrate, let's talk about how to set up a new disk with just one drive. Remember, you can't execute a BACKUP or even COPY one disk onto another without at least two drives.

The first step is to initialize the blank disk. This is done with the NEWDISK command. Insert a good FLEX disk into your drive and execute the NEWDISK command. When the utility comes back with ARE YOU SURE?, before answering and letting it proceed, take out your good disk and slip in the blank disk. Now answer yes and let the system initialize the new disk.

The next job is to copy some utilities from your old disk to the new one. The minimum number of utilities you will need for a usable system is:

SAVE.CMD—to save memory contents to disk
SAVE.LOW—to save other commands to disk
CAT—to print the directory (catalog) of the disk
DELETE—to delete files no longer needed

It might also be useful to copy the following utilities:

DOS.SYS—the FLEX DOS itself, so the system can be started with this disk
LINK—to link the DOS to the bootstrap
RENAME—to rename files
LIST—to print out the contents of text files
and possibly BASIC or EDIT, etc.

PTA provides a patch for the SAVE.CMD utility to allow saving on a disk that doesn't have the SAVE command. If you follow their instructions, you should have no trouble modifying the SAVE and then using it to save itself onto the new disk. But the SAVE.CMD utility lies in the same memory space as some of the other utilities, so it cannot be used to save them. Hence we need SAVE.LOW, another version of the SAVE, but which lies in low memory.

In general, we use the normal SAVE to save programs that are in low memory and SAVE.LOW to save programs in high memory. It is no problem to load SAVE.LOW off the original disk, but to save it on the new disk we need to know where in memory it is. And that is not in the manual.

So we need a way of looking at existing disk files and examining their addresses to see where in memory they belong. FLEX doesn't come with that utility, although a $99 FLEX Utilities package from Technical Systems Consultants (Box 2574, W. Lafayette IN 47906) does con-

Name	Addresses	Transfer Address
CAT	0100-02E7	0100
APPEND	0100-02CB	0100
LIST	7600-772C	7600
RENAME	7600-7673	7600
BUILD	7600-7690	7600
ASN	7600-76B6	7600
DELETE	7600-770E	7600
JUMP	7600-7622	7600
LINK	7600-7692	7600
NEWDISK	0200-05FB	0200
SAVE.CMD	7600-771E	7600
SAVE.LOW	0100-021E	0100
TTYSET	7600-773C	7600
DOS.SYS	7080-7FFF	7100
BASIC v. 3.0	0100-243D	0100

Table 1. Mini-FLEX routine addresses.

tain a MAP utility that will provide the starting and ending addresses and the transfer address for any disk file.

(As a slight detour, let's briefly describe this program package. It contains 36 disk utilities designed for Mini-FLEX (see the discussion of this topic in the November 1979 *Kilobaud Microcomputing*). I wish that the utilities were available separately, since in my opinion there are only a few in the package that are really useful; the rest will probably never be used by many. A listing of what they include is provided later.)

Fortunately, a similar utility called LOCATE, written by Dennis Womack, was published in the June 1979 issue of *68 Micro Journal* (PO Box 849, Hixson TN 37343). It allows you to determine where in memory a given disk file belongs. I find it to be almost indispensable to a single drive system.

In case you have the same problem, Table 1 has the information you will need for several of the more common utilities. (Caution: Table 1 is for version 1 of all of these utilities; there may be newer versions that may occupy slightly different memory addresses.)

So the procedure for copying a file, such as SAVE.LOW, goes like this:

1. Put the old (original) disk into your drive.

2. If you have the MAP or LOCATE utility, run it to find the first and last addresses of SAVE.LOW; if not, consult Table 1.

3. GET SAVE.LOW to load the utility into memory.

4. Take out the FLEX disk and put in the new disk you are loading.

5. Save the utility from memory onto the disk with, in this case, the command SAVE SAVE.LOW 0100 021E 0100. (This assumes you already have the modified SAVE on your new disk.)

From now on, each succeeding file gets transferred in exactly the same way, using either SAVE.CMD or SAVE.LOW to save it on the new disk.

There is one problem here: this procedure will not copy text files. Text files that happen to be BASIC programs can be loaded and saved by BASIC, but other files—such as text editor files—cannot. The simplest, though lengthy, method is to dump the file on cassette with the editor, then restart the editor with the new disk and read the text back in from cassette. This does require, though, that you copy the editor itself onto the new disk first.

A single-disk copy program can save the day. A Mini-FLEX version was shown on page 15 of the February 1979 issue of *'68' Micro Magazine*. Because of copyright problems, I can't reprint it here, but you may find it useful because it can copy all kinds of files—text and binary.

Putting a Pause in FLEX Utilities

The above discussion assumes that you save each utility on the disk you want to use it on. But there is another approach. The utility can be modified to pause after it is loaded long enough to let you switch disks. Here's how.

Every FLEX utility starts off with a sequence of instructions as shown in Example 1. That is, every FLEX utility starts with BRAnch (operation code 20), followed by an FCB. The purpose of the FCB is to hold the version number of the utility. All of the utilities that I have seen were version 01.

In some of the utilities, the CONT step comes right after the version number. In that case, the sequence is shown in Example 2. In these utilities, the first three bytes (20 01 01) could be removed without any trouble. The simplest thing is to replace them with a BD E1 AC—a JSR to INEEE. Then as soon as the utility is started, it will immediately wait for an input from the keyboard. You simply pull out the disk, put in the new one, hit any key on the keyboard and continue.

If CONT does not occur right after the version number, then a different approach is needed. The simplest approach is to replace the first three bytes with 7E E0 E3, that is, a jump back to the monitor. As soon as you see the monitor prompt, you switch disks and then jump to CONT from the keyboard. This means, of course, that you have to look at the utility first to see where that first BRA goes to.

The MON <Parameters> Approach

Most FLEX utilities require some parameters to be given to them when they are called. For instance, the LIST utility requires a filename right after the word LIST. You can supply the filename in a slightly different way.

To LIST a file called TEXT, type in the following:

```
LIST TEXT
```

FLEX accepts this line in a buffer, scans it for the command name LIST, sets a pointer past the LIST, loads LIST from the disk and then executes it. The LIST utility then uses the pointer, which FLEX had used to get the filename TEXT from the rest of the command line.

But there is another way to get the parameter to the LIST program. First, refer to Table 1 to find out that LIST starts at location 7600. Then proceed as follows:

```
GET LIST.CMD    Load LIST into
                memory, but do
                not execute
MON TEXT        Return to the
                monitor, but
                leave the pa-
                rameter TEXT
                in the FLEX in-
                put buffer
$J 7600         Now jump to
                the beginning
                of LIST.
```

When LIST starts, it goes to the buffer and takes out the filename, without even noticing that it was preceded by MON, instead of by LIST. And everything works exactly the way it is supposed to.

Now comes the good part. Since the loading of LIST from disk with the GET is done separately from the execution of it, you can switch disks any time between the GET and the J.

Since I have a Percom disk system as well as one FLEX-compatible drive, I keep one complete set of FLEX DOS and utilities on a Percom disk. The entire dialog for getting DOS and a few utilities on a blank disk is shown in Listing 1. (The Percom DOS is brought in from SWTBUG with the Z command; the Percom DOS prompt is >; and the FLEX prompt is + + +.)

Notice how we flit back and forth between the Percom DOS and FLEX. In each case, we prepare the parameters in the MON statement but actually call the FLEX routine from the Percom disk.

```
START BRA CONT
      FCB $01
      :
      :
CONT continuation of program
```

Example 1.

```
20 01  START BRA CONT
01           FCB $01
. . . . CONT . . . .
```

Example 2.

Transferring Text Files

Another problem is how to transfer text files from one disk to another or from a cassette-based (or other DOS-based) TSC Editor to FLEX. If you cannot get a copy of the single-disk copy program mentioned earlier, then you will have to do it the hard way.

First, we need to know that the pointers for the start and end of text in the TSC editors are in addresses 0097-009A in cassette, SSB disk and Mini-FLEX versions, and in 0098-009B in the FLEX 2.0 version.

Second, we need a graceful way of getting out of the Mini-FLEX editor back to the monitor without pushing RESET. The easiest way is to disable the GAP command by putting a 7E E0D0 instruction in location 141F; now a GAP command in the editor will go back to SWTBUG (I'm not sure what the correct address is in FLEX 2.0).

Now assume we want to transfer a file SAMPLE.TXT from disk 1 to disk 2. First, put a copy of the editor on both disks. (Disk 1 and disk 2 need not both have the same DOS; in my case, disk 1 might be a Percom disk, while disk 2 might be Mini-FLEX.)

On disk 1, start the editor with file SAMPLE.TXT. Once the editor is operating with the text, exit to the monitor. Look in the beginning and end-of-text pointers for the starting and ending addresses of the text and use the monitor (without reentering the editor) and save the entire text on cassette. (Write down the starting and ending addresses.)

In FLEX, this may leave an extra file on disk 1 with 0 sectors, since the name has already been entered into the directory, but no writing has been done. Just delete it.

Now go to disk 2. Again start the editor, giving SAMPLE.TXT as the filename. When the editor comes back with

NEW FILE
1.00 =

just type a number sign to get back into the editor command mode. Now gracefully get back to the monitor (using the modified GAP command) and then back into the DOS. Read the previously saved text from cassette and restore the pointers in 0097-009A. Then jump back into 0203, the editor soft-start location. Lo and behold, your text is now in the editor. A STOP command will write it on the disk.

The FLEX P Command

FLEX has a command called P that allows all output to be fed to a parallel printer connected to port 7. It actually requires two disk files: P.CMD and PRINT.SYS, which is used along with it. Whenever any command is preceded by the letter P, all output from that command is steered to the printer rather than the terminal.

For those of us who have a serial printer, however, this requires some changes. In my case, I have a serial printer on port 0 and a CRT terminal on port 1. I started changing the P and PRINT commands following instructions in the FLEX manual but eventually came up with a simpler method.

FLEX location 710D normally points to E1D1, the address of OUTEEE in the monitor. This vector is initialized every time FLEX restarts by the following two instructions:

```
71CD FE 7137   LDX $7137
71D0 FF 710D   STX $710D
```

and location 7137 therefore also has the address E1D1 in it. Hence, if we change the address in location 7137, we will force FLEX to use another output routine.

My TTY.CMD command is shown in Listing 2. (Addresses CB04 and CB16 point to port 0 I/O routines I have stored in a 2716 EPROM; see my article in the July 1979 issue for their listing.)

Thus, every time I call the TTY command, this routine initializes port 0 and puts into location 7137 the address of the above OUTPUT routine. Hence, all FLEX output will be echoed to my printer as well as to the CRT. When I want to go back to CRT-only operation, I execute a CRT command. CRT.CMD simply resets 7137 back to its original value of E1D1 and jumps to 7103, the FLEX soft-start address. CRT-CMD was stored on the disk with

SAVE CRT.CMD 7137 7138 7103

before location 7137/8 was modified.

This pair of commands has worked very well for me, and is much simpler than the approach suggested in the FLEX manual.

Port Change in TSC BASIC

TSC BASIC has no facility for changing the control terminal port; there is a way of switching to a printer on another port, but it is clumsy and requires quite a bit of programming know-how to implement. Here's an easier way to switch to a serial printer using an MP-S or MP-C card.

```
$Z                              Starts the Percom DOS
>DOS                            Loads and executes FLEX
FLEX 1.0                        FLEX is now in control
+++MON 0                        Return to SWTBUG with 0 in buffer
$Z                              Back to Percom DOS
>NEWDSK                         Execute NEWDISK on disk 0
ARE YOU SURE?  Y
SCRATCH DISK IN DRIVE 0?  Y
FORMATTING COMPLETE
TOTAL SECTORS = 612
+++MON DOS.SYS 7080 7FFF 7100     Prepare to save DOS
$Z
>SAVELO                        Fetch SAVE.LOW from Percom and run
+++MON DOS.SYS                 Get ready to LINK it
$Z
>LINK                          Get LINK from Percom and run it
+++MON LIST.CMD 7600 772C 7600    Prepare to save LIST
$Z
>L LIST                        Load LIST from Percom
>SAVELO                        and save it on FLEX disk
+++MON 0                       Prepare to do a CAT of drive 0
$Z
>CAT                           Execute a CAT 0

CATALOG OF DRIVE 0
 NAME   TYPE  SIZE

DOS     .SYS    33
LIST    .CMD     3

SECTORS LEFT = 576

+++
```

Listing 1. Initializing a FLEX disk on one drive.

FLEX, as well as TSC BASIC, uses the INEEE and OUTEEE routines in SWTBUG. Both of these use a pointer in the scratchpad RAM at location A00A, which points to 8004, the address of port 1. If you change that pointer to 8000, they will access port 0 instead; 8008 will access port 2, and so on, Actually, only the number in A00B need be changed from 04 to 00 or whatever.

You can do this in one of three ways:

1. By using the monitor M command
2. By writing a separate routine to store the required pointer
3. By doing a POKE in BASIC.

In SWTP BASIC, the POKE instruction would be

POKE (40971, 0)

while in TSC BASIC it might be

POKE HEX("A00B"),0

to switch to port 0. You can do this globally for an entire program, which would switch both input and output to that port, or you can steer only output to another port by poking in a 0 just before the PRINT and then poking back a 4 just after.

There's only one catch—that port must be initialized before it is used. You could write your own routine to initialize it, but in the case of port 0 there is a routine to do that in SWTBUG in the form of the O command. Typing an O E before going into FLEX initializes the port 0 interface. For this reason, port 0 is easier to use than other ports.

BASIC Bugs

SWTP Disk BASIC version 3.0 will work with ports other than the control port, but it does not like an MP-S port anywhere else than port 1. This is due to the way in which it tests for the presence of a valid port before using it. Though it's possible to modify the routine, the easiest way is to completely disable it by

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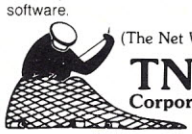
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changing the byte in location 1472 from 26 to 20. Just be sure not to try to use a port that has nothing connected. (Previous SWTP BASICs had the same problem; in cassette version 2.0, the location to change is 121B.)

When using port 0 with an MP-S, the MP-C initialization of port 0 should then be removed and initialization done separately. Change location 010C to 39 (RTS) and use the O E command to initialize your port 0.

BASIC version 3.0 doesn't like the combination ;: in a PRINT, as in

PRINT A$; :REM DON'T SKIP TO NEW LINE

Another statement it doesn't like is

FOR I = JTON

which is OK if spaces are inserted before and after the TO. Both fixes are probably not easy; the best answer is to just avoid the problem.

John Tucker of Laredo TX has sent me some other comments. With some printers, the extra control characters sent as part of a carriage return/line feed cause a space to be printed on some lines. He suggests changing location 053A to SWTP Disk BASIC version 3.0 to 00 to eliminate it.

He also reports a bug in early versions of TSC BASIC. If your CHR$, LEFT$, MID$ and RIGHT$ functions don't work, change location 1DD7 from 56 to 55.

He also mentioned that TSC BASIC makes an error with

```
10 F6=0
20 F8=1
30 LET F9=SQR(F8+F6)
```

A. G. Pearson of Austin TX also has reported some BASIC bugs. SWTP version 2.0 gives the wrong answer for ATAN(X) if X is negative. For example, ATAN(−.9999999) comes out +45 degrees (in radians, of course), while ATAN(−1) is −135 degrees. Both of these answers should be −45 degrees. He suggests that some of the formulas given in magazines, such as in the April 1978 issue of *Kilobaud Microcomputing* for arccos and arcsin have been doctored to make up for the wrong ATAN and will give the wrong answer if used with a BASIC that gives the right result for ATAN.

He also mentioned that TSC BASIC also makes errors with ATAN. By the way, it's called ATN in TSC BASIC. The example he gave was

```
10 A=ATN(-1)
20 PRINT A
30 X=TAN(A)
40 PRINT X
```

The value of A is printed correctly, but line 30 gives an error message. The moral here is that many BASICs don't handle tangents and arc-tangents correctly, so you must be careful.

He further mentioned that TSC BASIC will accept ? instead of PRINT and that PRINT FRE(0) will print the number of bytes still available.

Finally, TSC BASIC sometimes returns an EXPRESSION TOO COMPLEX when EXPRESSIONS should be simple enough to evaluate. If you have this problem, break up the expression into several smaller ones.

Black PR-40 Ribbons

Jim Weisjahn of Medford MN wrote in to let me know that black ribbons for a PR-40 are available from Addressograph-Multigraph as part number 116-2395-116 and cost $25 for a box of 12.

CT-64 Bugs

In the first installment of this series (March 1979), I mentioned that my CT-64 had some bugs and wondered whether others had them too. Reader letters indicate that many of my problems are fairly universal.

Sometimes a letter would appear smudged on the screen. In my case, sometimes, when an r followed a p, the r would have an extra horizontal line at the bottom.

Since I had an extra (defective) CT-64, I decided to swap parts around to see what happened. This particular problem seems to be related to the operating speed of the 2102 memories and the MCM6575L character generator. As they heat up, they apparently start to slow down a bit, and this causes the problem to appear.

I found that replacement of one or two 2102s usually solves the problem; the trick is to find which 2102. I use three techniques:

1. Tightly grab the IC, thumb over the IC and index finger on its pins, on the other side of the board. When you grab the defective IC, the errors on the display should get worse; grabbing ICs that are good should make little, if any, difference.

2. Take a 5 to 10 pF disk capacitor and ground one lead through a clip-lead. Carefully touch the other lead to pin 12 of each 2102 RAM. This is the output lead. If one of the RAMs is marginal in speed, the addition of this capacitor will slow down the output some more and make the error worse.

3. Use a circuit cooler spray to cool each RAM, one at a time. When you cool off the right IC, the display should get better.

Also try to cool the MCM6575L character generator; you will probably find that it, too, is heat sensitive. But it should not be replaced until after you try the memory tests.

IC replacement will work if the replacement ICs are fast. However, there are some 2102s around that are very slow. An access time of 450 ns seems just barely OK; 250 ns units are not much more expensive and should be a satisfactory choice.

Since heat seems to make it worse, limiting the temperature of these ICs is another approach. The CT-64 is not particularly well ventilated; a few small openings in the case might help. If you have 16 RAMs on the memory board but never use the second page, then removing the bottom eight will keep the top eight cooler.

If you suspect the MCM6575L, before replacing it, you might consider epoxying a small aluminum heat sink to its top; it normally runs very hot.

Another CT-64 problem is an occasional blank. A letter from Miguel Delgado in Brazil suggested a fix that he apparently got from SWTP. On the motherboard, cut pin 5 of IC33 and lift it up so it is disconnected from the board. Solder a wire from this lifted-up pin 5 to IC16, pin 11. He said that it completely cured his problem; unfortunately, it did absolutely nothing for my unit.

FLEX Utility Package

The 36 utilities in TSC's FLEX utility package are divided into six volumes of six utilities each. They include the following:

Volume 1:

FIND—searches a text file for occurrences of a specific text string.

WORDS—scans a text file and prints out the number of words and lines in the file.

TYPOS—prints out a listing of all words in a text file that occur fewer than a specified number of times. Ideal for looking for misspelled words.

SPLIT—splits a text file into two files.

LOW-UP—converts all lowercase letters in a file into uppercase.

UP-LOW—the opposite of LOW-UP.

Volume 2:

DUMP—prints the contents of a file in both hex and ASCII.

OLOAD—loads a binary file into a different region of memory than it is intended for. Ideal for PROMing programs.

CHECK—compares two files against each other and prints out their differences.

CMPMEM—compares a disk file against memory contents.

FILTYP—prints out whether a file is text or binary.

DUP—compares the directory of one disk to another and prints out differences. Requires two drives.

Volume 3:

```
A050  BD CB04  TTY     JSR IZPTO     Initialize Port 0
A053  CE A05C          LDX OUTPUT    Get pointer to routine
A056  FF 7137          STX $7137     Give it to FLEX
A059  7E 7103          JMP $7103     Jmp to FLEX soft start
A05C  36       OUTPUT  PSH A         Save the character
A05D  BD E1D1          JSR OUTEEE    Print on CRT terminal
A060  32               PUL A         Get character again
A061  7E CB16          JMP OUTPTO    Print it on printer
```

Listing 2. TTY.CMD utility listing.

MAP—prints out the loading and transfer addresses of binary files.
DIR—prints a more thorough disk directory, including disk sectors.
INSTALL—changes a BIN extension into a CMD extension.
FREE—prints the number of sectors and kilobytes still free on a disk.
REPLACE—combines the functions of a DELETE and RENAME.
TEST—tests all diskette sectors for errors.

Volume 4:

FILES—is a variation of the CAT command that omits the number of sectors printout.
PRUL—converts old TSC text processor files containing all uppercase letters into upper and lowercase files.
DATE—allows setting and checking the data register in the DOS.
RPT—repeats a command line a specified number of times.
ECHO—accepts keyboard input and sends it back to the terminal.
HECHO—similar to ECHO, but accepts input in hex.

Volume 5:

FLIST—version of LIST command, but allows the inclusion of line numbers and breaking up into pages.
PDEL—a prompting DELETE for deleting a number of files from a disk at the same time.
SLEEP—a time delay program.
REMSPC—removes space from a text file.
CONCAT—lists several files, one after another.
CONTIN—used in EXEC commands to give the operator a chance to continue the command or not.

Volume 6:

INTEG—tests the free sectors of a disk for data integrity.
RECOVER—allows specified sectors of a file to be copied to another disk. Especially useful for recovering the contents of a disk after its directory has been damaged.
MEMTEST—performs a memory test.
MEMDUMP—dumps a selected portion of memory.
MEMOVE—moves a block of data from one memory area to another.
MEMFILL—fills a memory area with a specified byte.

Power Supplies

The first installment of this series (March 1979) dealt with power supply regulation. I had at that time mentioned installing a voltage regulating transformer as one possibility. My Sola regulating transformer cost $190 but has saved the day on several occasions when the lights visibly flickered while my local power company had trouble delivering my 10¢-a-kwhr power without interruption.

Shortly after that, I received a letter from Gimix, Inc. (1337 West 37th Place, Chicago IL 60609), enclosing information on their new SS-50 system. The interesting thing about their system—aside from the fact that the cabinet looks as though it's built like a tank—is that their power supply contains a ferroresonant constant-voltage transformer to provide regulation. It would appear that in many locales having poor power, this might be a real necessity.

Power supply regulation seems to be a problem in general. On a recent visit to a minicomputer installation in one of New York's largest skyscrapers, I noticed two big regulators on the power line. It seemed that the system wouldn't run reliably without them. In our own office, we have run an IBM and a DEC system straight off the power line for years without problem, but our SWTP systems tend to crash fairly often, as does a Radio Shack TRS-80 and a Heath H8 that we tried. We are going to try regulators to see if they help.

Talking about cabinets, does anyone make a rack mount kit for the SWTP computer?

TRS-80 Graphics?

You can't help but see some of the games people play on Radio Shack's TRS-80 computer. How would you like to be able to run the same ones on your SWTP, and even get all the same graphics?

Photo 1 doesn't do it justice, but F & D Associates (1210 Todd Road, New Plymouth OH 45654)

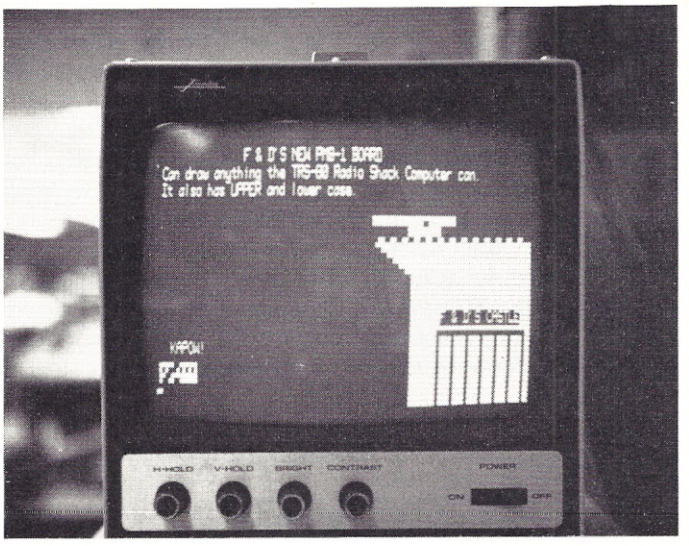


Photo 1. PBM-1 display.

has a new video board which does just that. It's their PMB-1 video controller, which sells for $37.50 for the bare board and documentation. It has several exotic ICs, including the Motorola MC6845 CRT controller and an MCM66714P character generator, so its parts cost may add another $100 or more, but even this is reasonable for what the board offers.

The MC6845 CRT controller allows the board to be programmed into a variety of display formats, such as 16 lines of 32 characters, 24 lines of 80 characters and many other combinations, although small board changes may be needed in some cases. As more characters are put on a line, the spacing between the dots used to generate them has to be smaller, and so an on-board crystal oscillator must run at a higher frequency. Also, the more characters displayed, the faster the on-board memory must operate to fetch and decode them.

The MCM66714P character generator (or one of the others in the MCM66700 series) allows a variety of standard character sets, including upper and lowercase. In addition, the board has room for either a 2716 or a 2708, which can contain special characters such as graphics or APL. The board, which F & D let me play with, had been preprogrammed to duplicate the TRS-80 graphics set.

The board also has room for up to 4K of RAM memory, which is the screen memory, but which can also be used for standard read-write operation. It's fascinating to watch the display as a BASIC program POKEs data into this memory area.

There is also room on the board for a 6820 or 6821 PIA for two parallel ports, which can be used for a parallel keyboard or printer. F & D Associates also has an EPROM monitor program that allows this keyboard and the video board to replace the serial terminal you normally need with an SWTP system. The board also has a lightpen input.

With all this, the board is extremely flexible, but it all depends on the MC6845 CRT controller. You must carefully read the spec sheet for this IC if you want to use some of its more advanced features. The board allows either black on white or white on black display, either on the full screen or for individual characters. Scrolling and paging are easy; the cursor is fully programmable, etc. The possibilities are quite staggering. But the most intriguing feature, to me at least, is the possibility of configuring the board so it behaves like something else.

To make life more interesting, F & D loaned me a modifed version of SWTP 8K BASIC version 2.3, which was expanded to include the TRS-80 graphics commands. These included CLS for clearing the screen, SET and RESET for turning a dot on the

screen on and off, INV for toggling it from on to off and vice versa and a PRINT AT command, which prints at a specified screen position. Using this BASIC, I was able to run a standard TRS-80 graphics program (see Photo 1).

Building this project is not for beginners. There are many options to consider before building, and F & D's instruction manual, though quite complete as far as diagrams are concerned, is a little skimpy on words. I started to build an earlier board of theirs a year or two ago but eventually just gave it up. Their present manual is better, but you still have to know where to search for what you need.

For instance, there are several DIP and rotary switches on the board for setting memory addresses for the control port and RAM. When I wanted to find out which switch did what, I wound up having to look up the function I wanted in the logic diagram, read the theory of operation section to confirm switch numbers and then search for them on the layout diagram.

While on the subject of video boards, another video board has recently been introduced by Thomas Instrumentation (2709 Dune Drive, Avalon NJ 08202). Their board is available either fully assembled at $135 or as a kit containing board, crystal and documentation for $35. Though this board is much less versatile than the F & D board, its low assembled price makes it much more attractive for people who don't feel up to assembling one from a batch of parts.

Like F & D, Thomas Instrumentation has a program that allows their video board, along with a parallel keyboard and a parallel port, to control the entire system, so that a serial terminal is not required. This seems to be a fairly inexpensive way of completing a system and get it operating. A more complete review of this board appeared in the March 1979 issue of *68 Micro Journal*.

Gimix also has a video board that can be used to replace a serial terminal. It is very versatile and has a 24 line by 80 character display, a full character generator plus EPROM and RAM space for user-defined graphics characters and more.

BASIC Renumbering

My BASEDIT program appeared in the January 1979 issue of *Kilobaud Microcomputing* ("An Editor for 6800 BASIC Programs," p. 22). Since then several readers have asked whether it could be modified to allow renumbering starting from another line number. The patch in Listing 3 shows how to modify BASEDIT so that, whenever you ask it to renumber a program, it will ask for a starting line number. After entering the line number, hit RETURN. If you enter more than four digits, only the last four will be accepted. Initial zeros are not required, and if only a RETURN is entered the default line number will be 1000. The line increment will still be 10, as in the original program.

BASIC Variable Names

Although it won't run, a BASIC program using meaningful variable names instead of things like A7 and Q5 is a lot easier to read. An editor, such as a disk editor or the cassette version of BASEDIT (a disk version is available from Star-Kits, PO Box 209, Mt. Kisco NY 10549, but is not needed in this case since a standard editor will do) can be used to change variable names.

Listing 4 shows how a simple program using variables such as F0 and R1 can be made more readable by replacing these variable names with more meaningful ones such as FWD-POWER

```
                    NAM   PATCH
                ************************************
                * BASEDIT PATCH TO PERMIT INPUT OF *
                * STARTING LINE NUMBER FOR         *
                * RENUMBERING A BASIC PROGRAM.     *
                * BY                               *
                * PETER A. STARK                   *
                ************************************

                * EQUATES
    (02E9)      LINENO EQU   $02E9
    (E07E)      PDATA  EQU   $E07E
    (E1AC)      INEEE  EQU   $E1AC
    (E1D1)      OUTEEE EQU   $E1D1
    (015C)      CRLF   EQU   $015C
    (0303)      SQLOOP EQU   $0303

                * MOVE START OF TEXT
    (0111)            ORG   $0111
0111 B7 04E8        STA A TEXT
    (0204)            ORG   $0204
0204 CE 04E8        LDX   #TEXT
    (021D)            ORG   $021D
021D CE 04E8        LDX   #TEXT
    (0254)            ORG   $0254
0254 CE 04E8        LDX   #TEXT
    (0378)            ORG   $0378
0378 CE 04E8        LDX   #TEXT
    (03E7)            ORG   $03E7
03E7 CE 04E8        LDX   #TEXT
    (0114)            ORG   $0114
0114 CE 04E9        LDX   #TEXT+1

                * ACTUAL PATCH
    (0300)            ORG   $0300
0300 7E 0498        JMP   PATCH
    (0498)            ORG   $0498
0498 86 31    PATCH LDA A #'1       SET DEFAULT TO 1000
049A B7 02E9        STA A LINENO
049D CE 04DC        LDX   #MSGSTR
04A0 BD E07E        JSR   PDATA     ASK FOR STARTING NUMBER
04A3 BD E1AC  INLOOP JSR  INEEE     ACCEPT NEXT DIGIT
04A6 81 30          CMP A #'0
04A8 2D 1B          BLT   NODIGT    CHECK IF IT IS A DIGIT OR NOT
04AA 81 39          CMP A #'9
04AC 2E 17          BGT   NODIGT
04AE F6 02EA        LDA B LINENO+1  IF A DIGIT, SHIFT LINE NUMBER LEFT
04B1 F7 02E9        STA B LINENO
04B4 F6 02EB        LDA B LINENO+2
04B7 F7 02EA        STA B LINENO+1
04BA F6 02EC        LDA B LINENO+3
04BD F7 02EB        STA B LINENO+2
04C0 B7 02EC        STA A LINENO+3
04C3 20 DE          BRA   INLOOP    AND WAIT FOR NEXT CHARACTER
04C5 81 0D    NODIGT CMP A #$D      IF NOT DIGIT, IS IT CR?
04C7 27 07          BEQ   FINISH    IF YES, FINISH
04C9 86 07          LDA A #7        IF NO, THEN RING BELL AND RETURN
04CB BD E1D1        JSR   OUTEEE
04CE 20 D3          BRA   INLOOP
04D0 BD 015C  FINISH JSR  CRLF
04D3 7A 02EB        DEC   LINENO+2  SUBTRACT 10 FROM LINE NUMBER
04D6 CE 04E8        LDX   #TEXT
04D9 7E 0303        JMP   SQLOOP    AND RETURN TO BASEDIT
04DC 20       MSGSTR FCC  ' START NO? '
04DD 53 54
04DF 41 52
04E1 54 20
04E3 4E 4F
04E5 3F 20
04E7 04             FCB   4
04E8          TEXT  RMB   1
                    END
```

Listing 3. BASEDIT patch to allow entering a starting line number.

```
0010 PRINT "SWR CALCULATOR PROGRAM"
0020 REM BY P. STARK
0030 INPUT "ENTER FORWARD POWER IN WATTS", F0
0040 INPUT "ENTER REVERSE POWER IN WATTS", R0
0050 F1=SQR(F0)
0060 R1=SQR(R0)
0070 S0=(F1+R1)/(F1-R1)
0080 PRINT "THE SWR IS "; S0; ": 1"

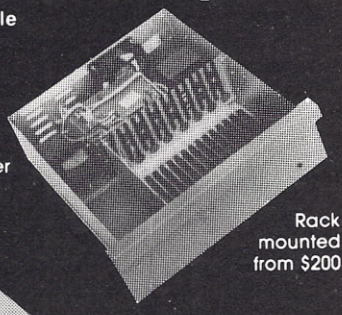

> R .F0. FWD-POWER .
> R .R0. REV-POWER .
> R .F1. FWD-VOLTS .
> R .R1. REV-VOLTS .
> R .S0. SWR .
> R .  . .
> P
0010 PRINT "SWR CALCULATOR PROGRAM"
0020 REM BY P. STARK
0030 INPUT "ENTER FORWARD POWER IN WATTS", FWD-POWER
0040 INPUT "ENTER REVERSE POWER IN WATTS", REV-POWER
0050 FWD-VOLTS =SQR( FWD-POWER )
0060 REV-VOLTS =SQR( REV-POWER )
0070 SWR =( FWD-VOLTS + REV-VOLTS )/( FWD-VOLTS - REV-VOLTS )
0080 PRINT "THE SWR IS "; SWR ; ": 1"
```

Listing 4. Editing BASIC to change variable names.

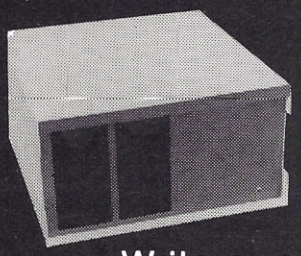
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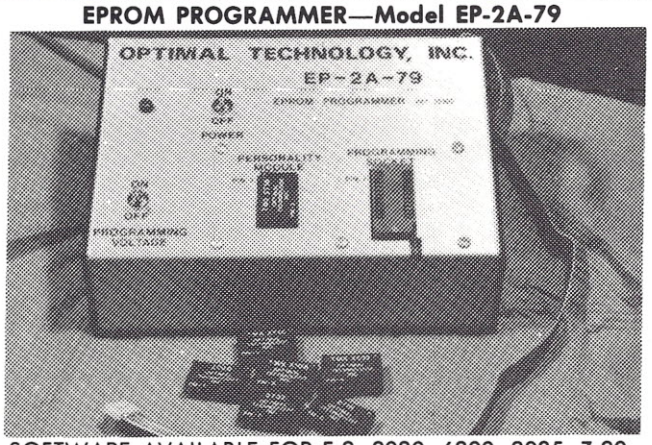
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EPROM type is selected by a personality module which plugs into the front of the programmer. Power requirements are 115 VAC, 50/60 HZ at 15 watts. It is supplied with a 36 inch ribbon cable for connecting to microcomputer. Requires 1 ½ I/O ports. Priced at $145 with one set of software, personality modules are shown below.

Part No.	Programs	Price
PM-0	TMS 2708	$15.00
PM-1	2704, 2708	15.00
PM-2	2732	25.00
PM-3	TMS 2716	15.00
PM-4	TMS 2532	25.00
PM-5	TMS 2516, 2716, 2758	15.00

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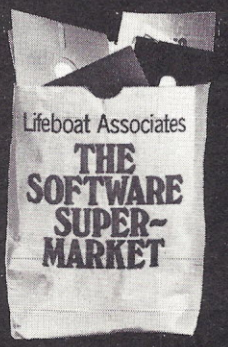
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Quality That's Affordable and Available: The Postmaster programs are available in a variety of 5" and 8" disk formats (40k of RAM, CP/M and CBASIC2 are required). Among the formats supported are TRS-80, North Star, Heath H8 and H89, standard 8" IBM, Vector MZ and other CP/M derivatives capable of running CBASIC.

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MANUAL ALONE: $15.

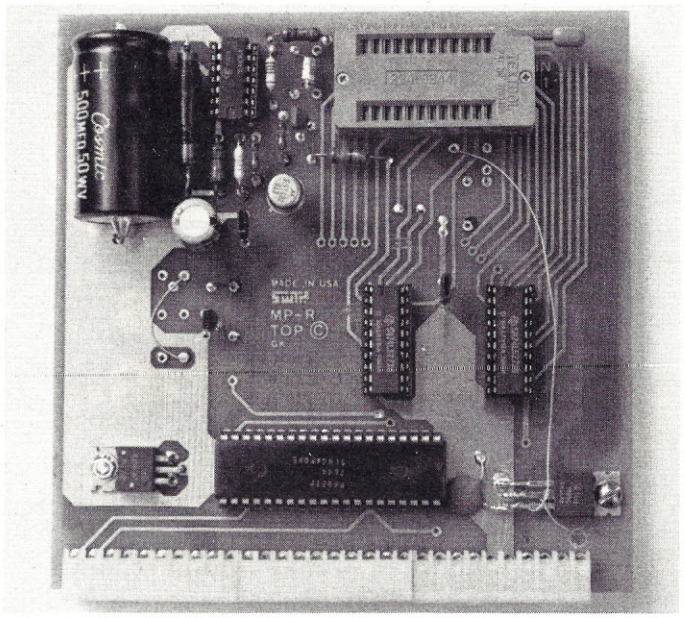
(Credited toward subsequent purchase)

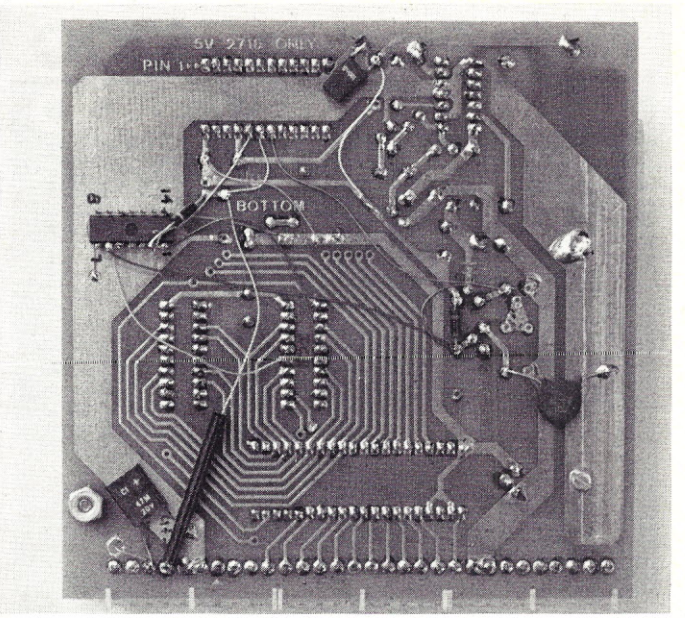


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Photos 2 and 3. Top and bottom views of the SWTP MP-R EPROM Programmer.

and REV-VOLTS. (This was done with the R or, Replace, function of BASEDIT.)

You can go both ways, of course—start with long names and then change them to short ones, which BASIC will accept just before running, or go the other way for documentation purposes.

But just remember that only variable names containing a letter and a digit will translate well; if you try to replace every occurrence of a variable such as R with RATE, then words such as PRINT will come out PRATEINT.

And if your printer has lowercase, you can use it in variable names to make the result look even better.

EPROMs

Some time ago we talked about PROMing BASIC, as well as some EPROM boards and programmers that are available. There are more.

An 8K 2708 EPROM board is available from Gimix (1337 West 37th Place, Chicago IL 60609) for $98.34; they also sell 2708s for $7.90, a very reasonable cost.

A 16K or 32K board from Digital Service & Design (PO Box 741, Newark OH 43055) can hold 16 memory ICs, which can be 2716 2K×8 EPROMs, 2758 1K × 8 EPROMs (like 2708s, but they only require 5 volts), TMS4016 2K × 8 RAMs or MK4118 1K×8 RAMs. But beware: TMS4016s are not yet available.

A 16K EPROM board that holds 16 2708s is available from Walter Wimberly (2914 Sunrise Dr., Orlando FL 32803) for about $25 for a bare board; not including the EPROMs, the additional parts cost would be about $40.

Notice that there is still a lot of activity in 2708 boards; the 2708 is so much cheaper than a 2716 that it still makes a lot of sense. Now all we need is a cheap 2708 programmer, about the price of the SWTP 2716 programmer!

Converting the SWTP 2716 Programmer for the 2708

Converting the SWTP MP-R programmer to work with the 2708 is an evening's job. All we need are two new ICs and a few small components. All of these parts fit into assorted spots on the board.

The 2708 differs from the 2716 in several ways. First, it needs three supplies instead of one. In addition to +5 volts, the 2708 also needs +12 and −5 volts for normal operation (both need +25 volts during programming only). The 2708 also needs one less address pin—ten leads instead of eleven.

Most important, 2708 programming is quite different from 2716 programming. To program a 2716, you first connect +25 volts to pin 21. Then you feed in the correct address and data for each byte to be programmed and put a 50 ms 5 volt pulse on pin 18. The locations can be programmed in any order, and just part of the IC can be done, if desired.

2708 programming requires that pin 20 be brought to +12 volts, the correct address and data be applied, and then a short 25 volt pulse of 1 ms or less be applied to pin 18. The entire EPROM must be programmed in sequence (you cannot do just part), and once you go through all 1024 locations, the programming process must be repeated 100 times or more.

The total pulse time for each location must be 100 ms. If each pulse is 1 ms long, then 100 repetitions are needed; if the pulse is 1/2 ms long, then 200 repetitions are needed and so on.

Since we must pulse 25 volts, instead of leaving it on continuously as in the 2716, the circuitry must be different. Since the timing is completely different, the program is different too.

Fig. 1 shows the parts that need to be removed from the SWTP MP-R programmer before starting. The original programmer has two 5 volt power supplies, one of which is switched on only when the 2716 is being used. In our case, we need three power supplies, and switching all of them on and off at the

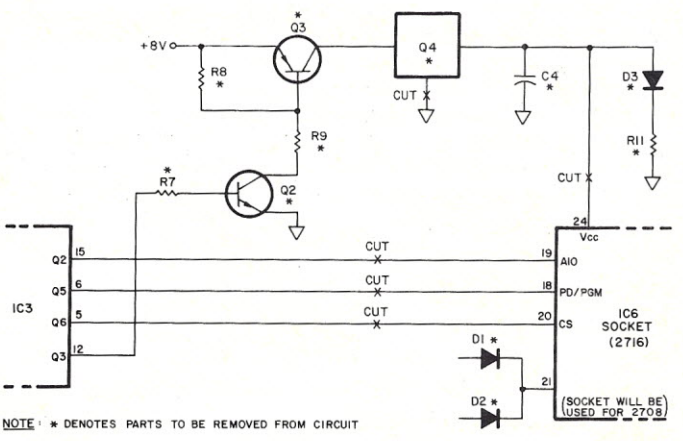


Fig. 1. Parts and connections to be removed from SWTP programmer.

same time takes more circuitry than we have room for, so the entire switchable 5 volt supply is removed and 5 volt power is applied all the time. This requires some care in inserting the EPROM into the socket. Also removed are the connections to pins, 18, 19, 20 and 21, which are all different from the 2708.

Fig. 2 shows the new components to be added: +5 volts is connected permanently to pin 24, and +12 volts is connected to pin 19. The latter should be regulated, but most SWTP 12 volt supplies are close to +12 volts and can often be used as is. In my case, the supply voltage was about 13.5 volts, so I connected two 1N4001 diodes in series to drop the voltage down to about 12 volts. You may need only one diode, or perhaps none. But caution: If you have modified your power supply to produce more than 13 volts or so, you may need a regulator.

As shown in Fig. 2, −5 volts is obtained from a 7905 regulator. It was mounted at the bottom of the board, on the opposite corner from the +5 volt regulator. But note: The tab on the 7905 is not to be grounded. Screw the regulator to an insulated part of the board.

A 7407 integrated circuit is needed to provide buffering. This is an open-collector buffer that can stand up to 30 volts on the output. I glued it to the bottom of the board, legs up, and wrapped the connections around its pins.

Switching the +25 volt power is done by two transistors: the two you removed from Q2 and Q3 can be used, but the wiring here must be done carefully. I used some of the extra holes left over after other parts were removed; but be careful not to short to some other connection.

The circuit is carefully designed to protect the 2708. When a RESET is done, all high-voltage power to the 2708 is removed. Thus you could plug the 2708 into the programmer board before turning on the power, if you feel uneasy about plugging it into a powered-up board. But I have had no problems with it.

Listing 5 shows the patches needed for the SWTP program to work with the 2708. The patched program works exactly like the original 2716 version and has all its functions. You can still check that an EPROM is unprogrammed, read it into memory, program a new one, verify that it is correct and edit the buffer contents. Just remember that the 2708 is a 1K × 8 EPROM, not 2K × 8. Hence, when the SWTP manual describes the buffer as being from 0800 to 0FFF, remember that the buffer size is now only 0800 to 0BFF. If you burn a long program into several consecutive EPROMs, adjust the buffer pointer accordingly.

The patch changes the SWTP program in several ways. It prevents programming just part of the EPROM; all 1K must be programmed. Since an erased EPROM has FF in all locations, the original program omits programming any location that should have an FF. The patch does not permit it.

The third part of the patch changes the pulse time from 50 ms to 1/2 ms and adds a loop to cycle through the programming sequence 200 times. It also adds a 15 second delay before and after programming to make sure that the power supply has a chance to stabilize at +25 volts.

It's not practical to add switching to use the same programmer for both 2716 and 2708 EPROMs. But still, this programmer is about the least expensive you can make.

Another 2708 programmer circuit was published in a Micro Works ad in the July 1979 issue of *68 Micro Journal*. It is the diagram of their 2708 programmer, and they suggest building it on one of their prototyping boards. The program was published in *Dr. Dobb's* several years ago. The prototyping board and further details are available from Micro Works (PO Box 1110, Del Mar CA 92014).

The prototyping board, by the way, is pre-etched for the installation of either a 6850 ACIA or a 6820/6821 PIA, as well as a voltage regulator. This greatly shortens the time required to wire the complete circuit.

What to Do with a 2708 Programmer

You can always PROM BASIC, or whatever, but here are some other suggestions.

If you have the Percom LFD-400 disk system with the MINI-DOS-PLUSX DOS, how about modifying your DOS? The file-protection code is at the "at-sign," which CT-64 terminals don't have. You can change locations C59F and C735 from 40

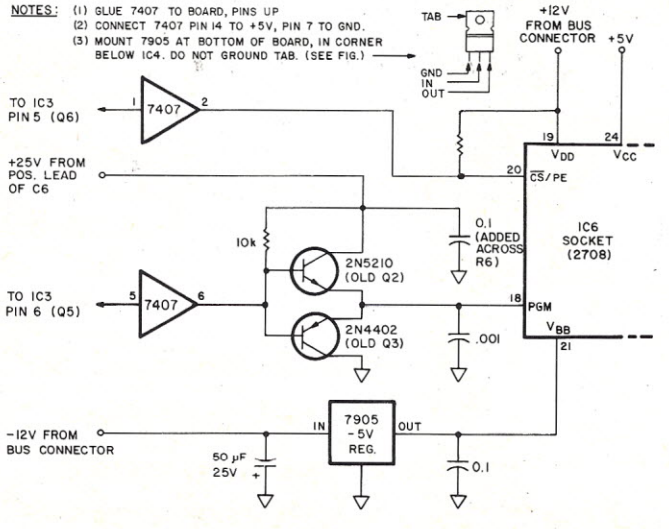


Fig. 2. Add these parts to SWTP programmer.

```
                    NAM    PROG2708
                ****************************************
                *                                      *
                * SWTP EPROM PROGRAMMER PATCH          *
                * MODIFIES SWTP MP-R 2716 EPROM BURNER *
                * VERSION 1.1 TO PROGRAM 2708 EPROMS   *
                *                                      *
                *          BY PETER A. STARK           *
                *                                      *
                ****************************************

                * LIMIT DEFAULT TO 1K MEMORY INSTEAD OF 2K
0037                    ORG    $0037
0037 03 FF              FDB    $03FF

                * REMOVE TEST WHICH OMITS PROGRAMMING $FF
0556                    ORG    $0556
0556 01                 NOP
0557 01                 NOP

                * CHANGE TIME DELAY FROM 50 MSEC PROGRAMMING
                * PULSE TO 0.5 MSEC PULSE
056D                    ORG    $056D
056D CE 00 35           LDX    #$35

                * CHANGE TO 15 SEC DELAY BEFORE AND AFTER BURNING
04FE                    ORG    $04FE
04FE C6 1D              LDA B  #$1D

                * DELETE ABILITY TO PROGRAM ONLY PART OF EPROM
04A5                    ORG    $04A5
04A5 01                 NOP
04A6 01                 NOP
04A7 01                 NOP

                * ADD LOOP TO CYCLE THROUGH PROGRAMMING SEQUENCE
                * 200 TIMES. 200 REPETITIONS OF 0.5 MSEC EACH
                * TOTAL 100 MSEC PROGRAMMING PER LOCATION
04C3                    ORG    $04C3
04C3 BD 07 F0           JSR    PATCH

07F0                    ORG    $07F0
07F0 86 C8      PATCH   LDA A  #$C8      INIT COUNTER TO 200 REPETITIONS
07F2 B7 07 FE           STA A  COUNT
07F5 BD 05 0A   AGAIN   JSR    $050A     GO THROUGH ONE COMPLETE CYCLE
07F8 7A 07 FE           DEC    COUNT
07FB 26 F8              BNE    AGAIN
07FD 39                 RTS
07FE            COUNT   RMB    1
                        END
```

Listing 5. Patch for the 2716 program to allow operation with the 2708.

to some other code; I have changed mine to 3E for a code of > for file protection.

I have made another change in my MINIDOS-PLUSX. It always bothered me that a full track of ten sectors was used for a directory, when, in fact, only two sectors were needed. I've made the following changes:

Location C6DF—change from 06 to 00
Location C6C3—change from 01 to 04
Location C6C6—change from B9 to BA

Now my files get stored starting at sector 002 on each disk, giving me a total of 348 usable sectors instead of 340.

Only one problem: if anyone else tries to read my directory with an unmodified MINIDOS-PLUSX, he will get a complete blank because his DOS will think that the directory is empty. (When it tests for and detects a track number of 00, it assumes that's the end. My first file begins on track 000 now, and so DOS stops printing.)

I still get a directory printout on my modified MINIDOS-PLUSX, but there's an easy fix: simply store a dummy file at the start of the disk, which takes up sectors 002–009, using the command

S DUMMY 0100 0800

Since this uses up sectors 002 through 009, the next file will start at 010, as usual. Then, after the disk is written on, delete DUMMY, so the first file starts again at 010.

How about a contest? I have my own monitor in EPROM, as do a lot of other SWTP users. Why not send me a listing of the routines you would like to see in a Super Monitor. We'll put them all together and see if we can't write a Super Monitor that does it all. If you enclose a self-addressed, stamped envelope, I will copy all entries submitted and send them back out—enclose a few extra stamps just in case it's thick.

Sudden Death Syndrome Revisited

In the first installment of this series, I mentioned a fix for the MP-A CPU board that would prevent sudden death of the system if a WAI instruction was encountered. The fix involved putting an extra gate in IC10 into the circuit.

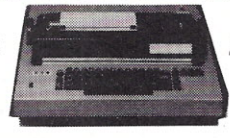
I forgot to add that this extra gate, though not used, has its input pin connected on the PC board anyway. To make use of it, you must cut the input lead at the board (or unplug IC10 and bend the lead out so it no longer connects to the board) before making the new connections. My apologies to anyone who has had trouble.

Conclusion

Next time, we'll talk about reassigning memory and I/O addresses, as well as a few more topics. ■

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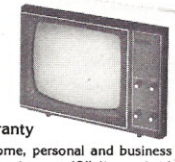
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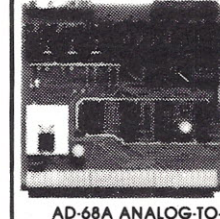


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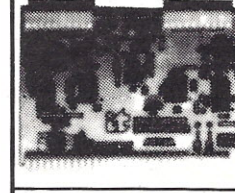
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✓ Reader Service index—page 241

Chesney E. Twombly
15 Storer Street
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H8 String Finder

Herein you'll find the third installment in the "CONOPS" series.

H8 String Finder program.

```
                        *  H8 STRING FINDER
                        *
                        *  FOR USE WITH "CONOPS".
                        *
                        *    BY CHESNEY E. TWOMBLY
                        *         15 STORER ST.,
                        *       KENNEBUNK ME 04043
                        *
                        *
                                 OPT    MEM,NUM
6700                             ORG    $6700
                        *
                  6FB0  STACK    EQU    $6FB0
                  6C62  OUT2H    EQU    $6C62
                  6DB4  MS1      EQU    $6DB4
                  6DC3  MS2      EQU    $6DC3
                  6C03  PDATA    EQU    $6C03
                  6C4C  IN4H     EQU    $6C4C
                  6C1D  INCHR    EQU    $6C1D
                  6C28  CONVT    EQU    $6C28
                  6C40  BYTE     EQU    $6C40
                  6C86  OUTS     EQU    $6C86
                  6DF0  ZBUF     EQU    $6DF0
                  6EDB  MONIT    EQU    $6EDB
                  6C11  CRLF     EQU    $6C11
                        *
6700 31 B0 6F     ENTER  LXI    SP,STACK
6703 CD F0 6D            CALL   ZBUF       ;CLEAR BUFR
6706 01 FF 00            LXI    B,00FFH    ;SET B=0, C=FF
6709 11 48 6F            LXI    D,STRING   ;SET PNTR TO STRING BUFR
670C 21 BA 67            LXI    H,MS6      ;"LOOK FOR - ".
670F CD 03 6C            CALL   PDATA
6712 CD 1D 6C     GETCHR CALL   INCHR
6715 FE 53               CPI    'S'
6717 CA DB 6E            JZ     MONIT      ;ALL DONE
671A FE 58               CPI    'X'
671C C2 28 67            JNZ    NOX
671F 48                  MOV    C,B        ;SET DONT CARE INDEX
6720 04                  INR    B
6721 CD 86 6C            CALL   OUTS
6724 13                  INX    D
6725 C3 12 67            JMP    GETCHR
6728 FE 0D        NOX    CPI    0DH        ;C/R= END OF INPUT
672A CA 3C 67            JZ     SEARCH
672D CD 28 6C            CALL   CONVT      ;CONVERT 2 HEX CHARS TO BINARY BYTE
6730 CD 40 6C            CALL   BYTE
6733 12                  STAX   D          ;PUT INTO BUFR
6734 04                  INR    B          ; INCR BYTE CNTR
6735 CD 86 6C            CALL   OUTS       ;OUTPUT A SPACE
6738 13                  INX    D          ;INCR STRING BUFR
6739 C3 12 67            JMP    GETCHR     ;GET ANOTHER STRING CHAR
                        *
673C 1B           SEARCH DCX    D          ;SET PNTR TO LAST CHAR
673D D5                  PUSH   D
673E D5                  PUSH   D
673F 21 B4 6D            LXI    H,MS1      ;"BEGIN ADDR? "
6742 CD 03 6C            CALL   PDATA
6745 CD 4C 6C            CALL   IN4H       ;GET START ADDR OF BLOCK TO BE SEARCHED
6748 EB                  XCHG
6749 22 40 6F            SHLD   BEGADR     ;SAVE IT
674C 21 C3 6D            LXI    H,MS2      ;"END ADDR? "
674F CD 03 6C            CALL   PDATA
6752 CD 4C 6C            CALL   IN4H       ;GET END ADDR OF BLOCK TO BE SEARCHED
6755 EB                  XCHG
6756 22 42 6F            SHLD   ENDADR     ;SAVE IT
6759 CD 11 6C            CALL   CRLF
675C D1                  POP    D
                        *
675D C5           MATCH  PUSH   B
675E D5                  PUSH   D
675F 05           MATCH2 DCR    B
6760 FA 82 67            JM     DONE       ;STRING MATCH
6763 D5                  PUSH   D
6764 E5                  PUSH   H
6765 CD 9C 67            CALL   CHKEND
6768 E1                  POP    H
```

Do you have trouble finding strings? Don't despair. Here is a string finder that will give you instant relief and runs as a part of "CONOPS," the H8-console-oriented operating system (*Microcomputing*, July 1979, p. 108). It will search any block of memory (RAM or ROM) for a sequence of one or more bytes and list the address of each occurrence.

Why do you need to find strings? Perhaps you wish to modify a program or relocate it in memory. Either of those actions involves changes of specific instruction bytes within the program. Before you can change them, you have to find them.

Many CONOPS subroutines are useful in other assembly-language programs, which is convenient. Unfortunately, modifying the operating system itself or relocating it, as new memory boards are acquired, calls for changing some addresses in the dependent programs. This string finder is convenient as a tool in finding those bytes that have to be changed.

The Program

The H8 String Finder program fits into the memory block 6700-67D0 hex, just below the disassembler (see *Microcomputing,* January 1980, p. 144). The entry address is 6700 hex.

When you run the program, the message LOOK FOR is displayed. At this time, enter the byte string to be searched for. This can be as few as one byte or as many as the string buffer will hold. The program sets no limit; however, I have not yet found any need to look for strings of more than four or five bytes.

You can enter the letter X in place of any byte, but only once per string. An X byte will be regarded by the program as a "don't-care" byte. For example, in studying an undocumented program, you may have identified a subroutine beginning at address 6712 hex. You wish to search the entire program and find every instruction that calls this subroutine. Entering X 12 67 will get you a list of all types of CALL or JMP instructions (18 possible) that reference the 6712 address. You could have

used just the two-byte address without the X, but chances are you would get a list containing a large number of irrelevant addresses. After you have tried it a few times, you will see the usefulness of a "don't-care" byte.

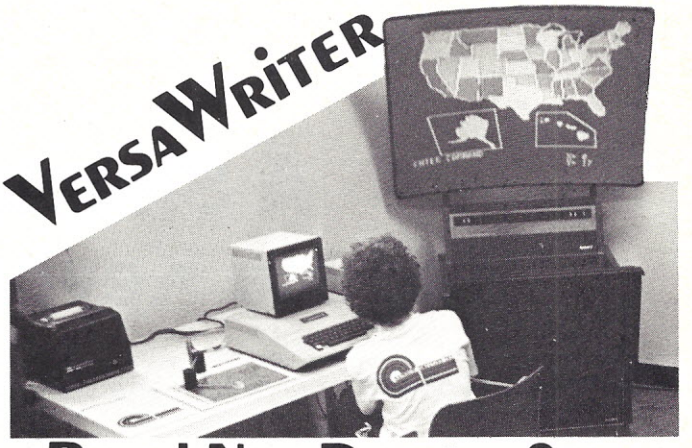
Terminate string entry with a carriage return. Now, respond to the prompts, BEGIN ADDR? and END?, by entering the beginning and ending address of the block to be searched.

The program will display a list of all addresses containing bytes that match the string searched for. If no match is found, the message NO MATCH will be displayed. The program ends with return to the operating system standby prompt, ***.■

```
  77   6769 D1              POP   D
  78   676A 1A              LDAX  D
  79   676B 96              SUB   M
  80   676C 1B              DCX   D
  81   676D 2B              DCX   H
  82   676E CA 5F 67        JZ    MATCH2
  83   6771 78              MOV   A,B
  84   6772 B9              CMP   C
  85   6773 CA 5F 67        JZ    MATCH2
  86                *
  87   6776 2A 42 6F  MORE2 LHLD  ENDADR
  88   6779 2B              DCX   H
  89   677A 22 42 6F        SHLD  ENDADR
  90   677D D1              POP   D
  91   677E C1              POP   B
  92   677F C3 5D 67        JMP   MATCH
  93                *
  94   6782 23        DONE  INX   H
  95   6783 22 44 6F        SHLD  ADDOUT    ;STORE MATCH ADDR
  96   6786 21 45 6F        LXI   H,ADDOUT+1
  97   6789 CD 62 6C        CALL  OUT2H
  98   678C 2B              DCX   H
  99   678D CD 62 6C        CALL  OUT2H
 100   6790 CD 11 6C        CALL  CRLF
 101   6793 21 47 6F        LXI   H,NMATCH
 102   6796 3E FF           MVI   A,0FFH
 103   6798 77              MOV   M,A
 104   6799 C3 76 67        JMP   MORE2
 105                *
 106   679C E5        CHKEND PUSH  H
 107   679D 2A 40 6F        LHLD  BEGADR    ;SET PNTR
 108   67A0 2B              DCX   H
 109   67A1 EB              XCHG
 110   67A2 E1              POP   H
 111   67A3 7A              MOV   A,D
 112   67A4 AC              XRA   H
 113   67A5 C0              RNZ
 114   67A6 7B              MOV   A,E
 115   67A7 AD              XRA   L
 116   67A8 C0              RNZ
 117   67A9 21 47 6F        LXI   H,NMATCH
 118   67AC 7E              MOV   A,M
 119   67AD 1F              RAR
 120   67AE DA DB 6E        JC    MONIT
 121   67B1 21 C6 67        LXI   H,MS7     ;"NO MATCH"
 122   67B4 CD 03 6C        CALL  PDATA
 123   67B7 C3 DB 6E        JMP   MONIT
 124                *
 125   67BA 0D 0A     MS6   DB    0DH,0AH
 126   67BC 4C 4F 4F        DB    'LOOK FOR ',4
       67BF 4B 20 46
       67C2 4F 52 20
       67C5 04
 127   67C6 0D 0A     MS7   DB    0DH,0AH
 128   67C8 4E 4F 20        DB    'NO MATCH',4
       67CB 4D 41 54
       67CE 43 48 04
 129                *
 130   6F40                 ORG   $6F40
 131                *
 132   6F40           BEGADR DS    2
 133   6F42           ENDADR DS    2
 134   6F44           ADDOUT DS    2
 135   6F46           NBR    DS    1
 136   6F47           NMATCH DS    1
 137   6F48           STRING DS    9
 138                *
 139                          END


SYMBOL TABLE:

ADDOUT 6F44   BEGADR 6F40   BYTE   6C40   CHKEND 679C   CONVT  6C28
CRLF   6C11   DONE   6782   ENDADR 6F42   ENTER  6700   GETCHR 6712
IN4H   6C4C   INCHR  6C1D   MATCH  675D   MATCH2 675F   MONIT  6EDB
MORE2  6776   MS1    6DB4   MS2    6DC3   MS6    67BA   MS7    67C6
NBR    6F46   NMATCH 6F47   NOX    6728   OUT2H  6C62   OUTS   6C86
PDATA  6C03   SEARCH 673C   STACK  6FB0   STRING 6F48   ZBUF   6DF0
```

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Reader Service index—page 241

A Simple Way to Reduce Keyboarding Effort

Excessive keyboarding is dreary and wearying. This shortcut reduces tusk-tickling time.

Theodore C. Hines
Lois Winkel
Rosann Collins
Library Science/Educational Technology Division
University of North Carolina at Greensboro
Greensboro, NC 27412

We keyboard a great deal of data on our three microcomputers—two in the office and one at home. After awhile, keyboarding becomes tiresome. We have a shortcut that helps, however, and would like to pass it along to others who have considerable word processing to do.

Recently, for example, we had to type out a long list of titles of legal periodicals as part of a bibliography we were working on. By using only a small set of abbreviations and then expanding them to full form by program, we cut our input keying effort by 30 percent. The abbreviations we used were simple, easy and logical, such as "j" for "Journal of," "a" for "Association," "b" for "Bar," "r" for "Review" and so on.

As it happens, we were using a good word-processing program (Michael Shrayer's Electric Pencil) as a data collector and editor, so we did not even have to do any programming of our own in this case. The Electric Pencil has a search and replace command of the form

```
j /Journal of /n
```

where j is the abbreviation, Journal of is the replacement and n is any number larger than or equal to the number of times the replacement is to be made. Type in the command, wait briefly while the computer does its thing, and the changes are made. The Electric Pencil even reports back on how many times it has expanded your abbreviation to the full form.

The Program

Writing a program to carry out such replacements is relatively simple to do either as a subroutine in a data-collecting program or as a standalone program that reads in data in abbreviated form from one file and writes it out in full form on another.

The second alternative has the advantage that you can store and/or manipulate the data in their abbreviated form. A brief and not very elegant program to expand abbreviations in this way (in Processor Technology Extended Cassette BASIC) is shown in the program listing to illustrate the process.

There are, as with anything else in computing, some minor glitches to watch out for. It is a good idea to use easy-to-remember abbreviations. It is an equally good idea to be sure these mnemonic abbreviations are unique in your given text. In keyboarding a book index in which the word "Children" appeared frequently, we used "C." as an abbreviation. The system worked well—except that not only was "Books for C." properly expanded to "Books for Children," but also "Walters, Joseph C." became "Walters, Joseph Children," a result we did not intend.

One way to circumvent this is to use a character or a combination of keystrokes for your abbreviation that never appears in normal or running text—a punctuation mark standing alone or immediately preceding a letter, for example.

```
 10 REM- PROGRAM TO EXPAND ABBREVIATIONS
 20 REM- ABBREVIATIONS AND THEIR EXPANDED FORMS ARE PUT
 30 REM- IN DATA STATEMENTS
 40 DIM A$(265),B$(65),C$(65)
 50 INPUT A$
 60 REM- AT THIS POINT PUT IN READ FROM FILE OR MEMORY,
 70 REM- INPUT A$ USED HERE FOR TESTING
 80 IF A$="" THEN 250
 90 LET A$="  "+A$+"  "
100 REM- THIS PADS RECORD WITH TWO SPACES ON EACH END, SO
110 REM- THAT ABBREVIATIONS OCCURRING IN THE FIRST OR LAST
120 REM- POSITION CAN BE IDENTIFIED AND EXPANDED EASILY
130 READ B$
140 IF B$="END" THEN  GOTO 200
150 READ C$
160 SEARCH B$,A$,X
170 IF X=0 THEN  GOTO 130
180 LET A$=A$(1,X-1)+C$+A$(LEN(B$)+X)
190 GOTO 160
200 LET A$=A$(3,LEN(A$)-2)
210 REM- THIS REMOVES TWO SPACES PADDED ON EARLIER
220 PRINT A$
230 RESTORE
240 GOTO 50
250 END
260 DATA " b "," Bar "," j "," Journal "," l "," Law "
270 DATA " a "," Association "," US "," United States "
280 DATA "UNCG","University of North Carolina at Greensboro"
290 DATA " jo "," Journal of "," r "," Review ","END"
```

Program listing.

Analysis Technique

We did not, of course, invent this technique of keying abbreviations and expanding them by program. We would suppose that the method has been used intuitively for years. An excellent study by Dr. James H. May (to be published) of input keyboarding for information retrieval systems provides a scholarly background and a documented rationale for devising and using such abbreviations.

As May explains and illustrates, in most data bases (and much text in particular fields), a kind of telegraphic style is used. In such data, certain long words or phrases may occur with much higher frequency than in normal English: "magnetic spin resonance" in chemistry, for example, or "United" and "States" in Library of Congress subject headings for books.

If you have a great deal of keyboarding of the same type of data to do, it might be quite useful to apply May's analysis techniques to a representative sample of the data to see what small set of abbreviations or codes would save the most keystrokes with the least effort.

As applied to words, the analysis technique consists of making a frequency count of the words in each sample and, for each word, multiplying its frequency by its length and then printing out a list of the words ranked by this figure. If "the" occurs 520 times, for instance, the

```
RUN
?US l r
United States Law Review
?UNCG jo l
University of North Carolina at Greensboro Journal of Law
?jo the American b a
Journal of the American Bar Association
?
READY
```

Sample run.

number of letters is 3 × 520, or 1560. Suppose that, in the same data, the phrase "University of North Carolina at Greensboro" occurs only 37 times. Keying a one-character abbreviation for either saves about the same number of keystrokes.

A similar analysis technique can be used to compress data files. In this instance, unused characters in the character set (ASCII characters over decimal 138, for example) can be substituted for words or phrases. Depending on the nature of the data, compression rates of 50 percent or more can be achieved with relatively few abbreviations.

The virtues of this technique are that, unlike some packing methods, there is a one-to-one relationship between the compressed and full versions, i.e., the compressed version can be expanded, character for character and space for space, to the exact original. Also, if the same compression technique is used with search requests, they can be run against the compressed data with exactly the same results as if the full search request were run against the original data.

We hope the simple tip on using abbreviations in input can save you as much work as it has—and is—saving us.■

KEYBOARD EXPANDOR
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C&H Micro announces the transformation of the APPLE II into a complete upper and lower case system. KEYBOARD EXPANDOR, a hardware-software modification of the APPLE II, actually allows the shift keys to be used just like a conventional typewriter.

The hardware change is a one-wire modification requiring one solder point. The software is a 1/4K transparent machine language routine which augments the Monitor. All APPLE characters and editing keys maintained. Cap and Shift Locks and an Inverse mode display option included. Compatible with methods displaying ASCII such as Paymar's LCA and the HI RES CHARACTER GENERATOR. Totally compatible with DOS, allowing use of U/L in TEXT files, PRINT and REM statements, DOS file names, and Immediate mode.

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01 = ENTER NAMES/ADDRESS, ETC.
02 = *ENTER/PRINT INVOICES
03 = *ENTER PURCHASES
04 = *ENTER A/C RECEIVABLES
05 = *ENTER A/C PAYABLES
06 = ENTER/UPDATE INVENTORY
07 = ENTER/UPDATE ORDERS
08 = ENTER/UPDATE BANKS
09 = EXAMINE/MONITOR SALES LEDGER
10 = EXAMINE/MONITOR PURCHASE LEDGER
11 = EXAMINE/PRINT INCOMPLETE RECORDS
12 = EXAMINE PRODUCT SALES

SELECT FUNCTION BY NUMBER
13 = PRINT CUSTOMER STATEMENT
14 = PRINT SUPPLIER STATEMENTS
15 = PRINT AGENT STATEMENTS
16 = PRINT TAX STATEMENTS
17 = PRINT WEEK/MONTH SALES
18 = PRINT WEEK/MONTH PURCHASES
19 = PRINT YEAR AUDIT
20 = PRINT PROFIT/LOSS ACCOUNT
21 = UPDATE END MONTH FILES
22 = PRINT CASH FLOW FORECAST
23 = ENTER/UPDATE PAYROLL (NOT YET AVAILABLE)
24 = RETURN TO BASIC

WHICH ONE? (ENTER 1-24)

Each program goes to sub menu, e.g.:
(9) allows A, LIST ALL SALES; B, MONITOR SALES BY STOCK CODES;
C, RETRIEVE INVOICE DETAILS; D, AMEND LEDGER FILES;
E, LIST TOTAL ALL SALES.

Think of the possibilities and add to those here if you wish.
Price for current package Version 1 is $550, or Version 2 (including aged debtors analysis, etc.) is $750, or full listing, $300.
All programs in BASIC for SWTP 6800/Pet 16/32K Systems/Z80 Stroke CPM Systems/Package includes 31 programs.

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User Report: The Heath H14 Line Printer

This article gives you a quick look at Heathkit's H14 Line Printer.

Thomas A. Prewitt
2212 S. Webster St.
Kokomo IN 46901

The Heathkit H14 is a versatile, moderate-speed dot-matrix line printer that offers many advanced features at an attractive price. An on-board microprocessor generates a full 96-character upper/lowercase type font and also controls software-selectable line spacing, top of form command and character width selection of 80, 96 or 132 characters per line. Paper out and paper jam detectors are included, as is a local test switch that prints a line containing the complete character set.

Although recommended for RS-232 operation at 4800 baud, the H14 may be configured for 20 mA current operation as well. At a maximum instantaneous print rate of 165 characters per second, print speed is about 32 full lines per minute. Printhead temperature is sampled after each line, and print speed is cut back if necessary to prevent head overheating on long runs. A 256-character line buffer stores incoming characters until a carriage return is detected. A complete line is then printed while the buffer accumulates the next line of text.

The H14 is assembled on a sturdy, one-piece die-cast base and fitted with an attractively styled hinged plastic cover. An adjustable tractor feed accepts only edge-perforated Z-fold paper forms of up to 9 1/2 inches in width, and a welded wire paper tray neatly stacks finished output. Since the machine uses a popular-style typewriter ribbon, replacements are inexpensive and readily available.

To one accustomed to the clatter of a teleprinter, the H14 seems remarkably quiet when printing. Since its mechanism runs only when actually printing a line, it is totally noiseless when awaiting output from the computer. Print quality is fairly good, although slightly on the light side, but is quite acceptable for program listings and some commercial applications such as invoices, which are commonly printed in uppercase.

Lowercase is somewhat difficult to read, since the 5 × 7 print matrix does not allow descenders on lowercase letters such as g and y. For this reason, I do not recommend the H14 for word-processing applications or business correspondence.

Limitations

Assembly of the H14 is clear-cut, and I encountered no unusual problems in building it. Most components are mounted on the main circuit board, with the stepper motor driver circuits on a small separate board. Numerous errata sheets, along with unused hole patterns on the main board, suggest that the stepper driver originally was on the main board, but a redesign added components, forcing the addition of the second board.

Unfortunately, the usually excellent Heath documentation group had not fully caught up with this change, and the first task I faced was to add 13 pages of text changes and "tape-in" sheets to the manuals. Even these did not completely document all the changes, as errors remained in the final test procedures, the large schematic diagram and the circuit description of the stepper driver. Also, the fold-in schematic diagram was omitted from the operation manual.

While I feel sure that Heath will correct these problems in subsequent production runs, they should also consider mailing a corrected operation manual when available to those who received kits from production run 01916.

My completed kit operated when first powered up, but produced ragged-looking tabulated columns. A note to the Heath technical assistance department brought a prompt response from Technical Consultant Jim Buszkiewicz, who diagnosed the problem as a slipping clutch and recommended that it be set tighter than specified in the assembly manual. This corrected the problem, and the machine now tabs accurately. The ribbon drive mechanism had a tendency to bind, but by enlarging the holes in the two drive ratchets, I easily corrected this. I encountered no other difficulties, and the machine gives the overall impression that it will be reliable and require little maintenance.

Interfacing

Interfacing the H14 to a Heath H8 or H11 computer is readily accomplished with the H8-4 or H11-5 I/O card. It is necessary only to set the mode jumpers and the baud rate switches on the card and printer to the recommended 4800 baud RS-232 configuration. The H14 may be operated at full-rated speed with other computers that have serial RS-232 or 20 mA current loop outputs with provisions for handshaking through either a separate sense line or reverse data channel.

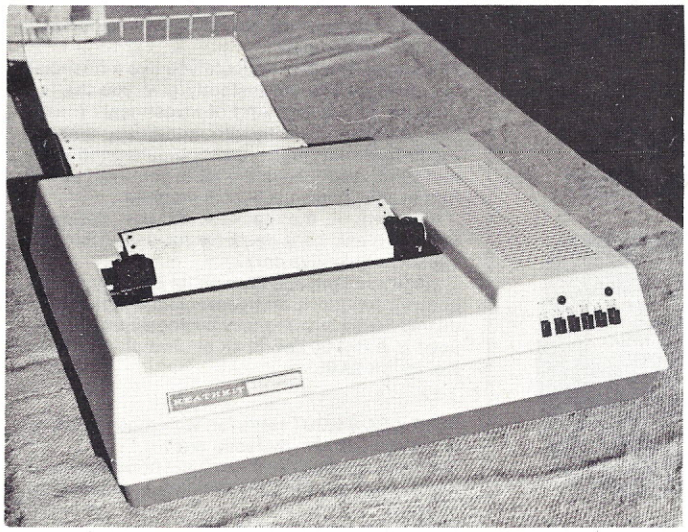
In the handshaking mode, the

computer sends characters to the printer at a fast rate until the printer buffer is nearly full. When this condition occurs, the handshake signal changes state, signaling the computer to wait until the buffer is ready to accept more characters. Operation with handshaking also gives protection against loss of characters if the paper forms run out or jam, or if the head temperature-limiting circuit cuts back the print rate.

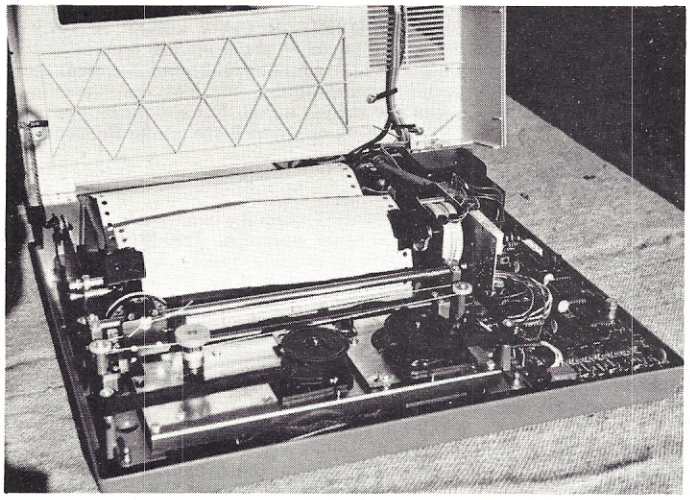
The H14 also may be connected to operate on a one-way 110 baud, 20 mA current loop, directly replacing an ASCII teleprinter. At the 110 baud rate, handshaking is not needed since the printer always can empty the buffer faster than the data channel can fill it.

My preliminary efforts to interface the H14 to my Digital Group computer indicate that it runs nicely from the non-handshake serial 20 mA output port of that machine at a 600 baud data rate, after I modified the software driver to add a 500 ms delay after each carriage return character.

At the current kit price of $625, the H14 deserves consideration by those needing a line printer for a home or light-duty commercial application. ■



H14 printer and paper tray. Push-button function controls and status indicators are on the front panel at the right.



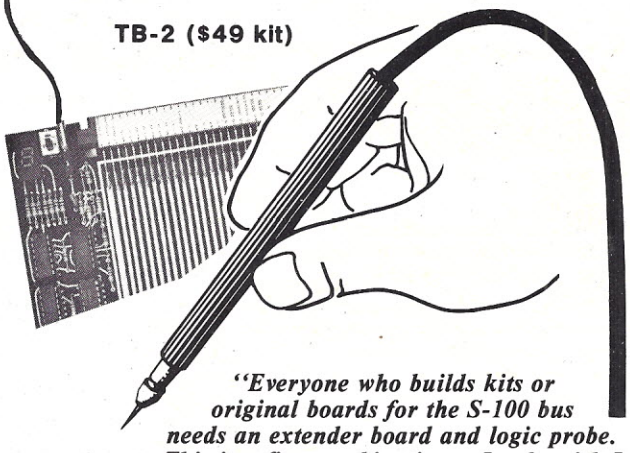
With cover raised, printer mechanism is completely accessible for forms setup, ribbon replacement and cleaning. Test button on circuit board prints line containing complete character set.

MULLEN Computer Products

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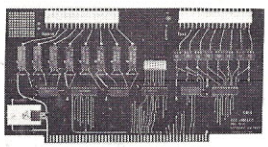
TB-2 ($49 kit)



"Everyone who builds kits or original boards for the S-100 bus needs an extender board and logic probe. This is a fine combination. I only wish I had mine two years ago."

Robert L. Leffert
Kilobaud Microcomputing
August 1979

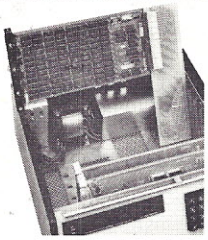
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Reader Service index—page 241

SOFTWARE FOR 1980 — AND BEYOND

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Level I and II

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This is the perfect package for any ham or technician. **Order No. 0007R $7.95.**

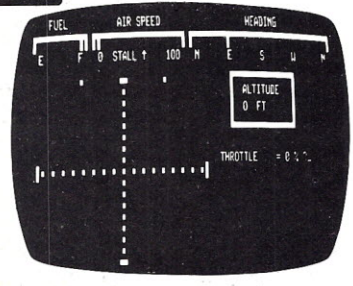
ELECTRONICS I This package will not only calculate the component values for you, but will also draw a schematic diagram. You'll need a TRS-80 Level I 4K, Level II 16K to use:
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- **555 Timer Circuits** — Quickly design astable or monostable timing circuits using this popular IC.
- **LM 381 Preamp Design** — Design IC preamps with this low-noise integrated circuit.

This package will reduce your designing time and let you build those circuits fast. **Order No. 0008R $7.95.**

Designed for use on TRS-80* 4K LEVEL I 16K LEVEL II

Air Flight Simulation

* A trademark of Tandy Corporation



AIR FLIGHT SIMULATION Turn your TRS-80 into an airplane. You can practice takeoffs and landings with the benefit of full instrumentation. This one-player simulation requires a TRS-80 Level I 4K, Level II 16K. **Order No. 0017R $7.95.**

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- **Backgammon** — Play against the computer. Your TRS-80 will give you a steady, challenging game that's sure to sharpen your skills.
- **Keno** — Enjoy this popular Las Vegas gambling game. Guess the right numbers and win big.

You'll need a TRS-80 Level I or II. **Order No. 0004R $7.95.**

BOWLING Let your TRS-80 set up the pins and keep score. One player can pick up spares and get strikes. For the TRS-80 Level I 4K, Level II 16K. **Order No. 0033R $7.95.**

BUSINESS PACKAGE IV Business Package IV gives you, the businessman, a superb tool to help you make those important decisions. This package includes:
- **Business Cycle Analysis** — This program isn't a crystal ball, but it can show you your business's expansion and contraction cycles. You can plot any aspect of your business on a graph and see, in black and white, just what's happening. This program will give you access to information you couldn't get before.
- **Financial Analysis** — Would you like a financial assistant who could instantly give you the figures for almost any kind of investment? Financial Analysis can handle annuities, sinking funds, and mortgages, and compute bond yield and value. You'll have the facts you need at the tips of your fingers with this program.

Included in the package is one specially marked blank data cassette for use in storing essential business data.

Business Package IV, with its combination of analytic functions and convenience features, is an invaluable asset for any businessman. All you need is a TRS-80 Level I 4K or Level II 16K. **Order No. 0019R $9.95.**

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Level I

CAVE EXPLORING/YACHT/MEMORY These three programs are not only fun, but stimulating as well:
- **Cave Exploring** — Search for fabulous treasures as you explore the magic cave. For one player.
- **Yacht** — A two-player game of strategy and chance. The computer rolls the dice and keeps score.
- **Memory** — Two players can pit their memories in this program based on a popular television show.

You'll need a TRS-80 with Level I and 16K. **Order No. 0010R $7.95.**

CAR RACE/RAT TRAP/ANTIAIRCRAFT Enjoy these challenging, fun-filled programs:
- **Car Race** — You and a friend can race on a choice of two tracks.
- **Rat Trap** — Trap the rat in his maze with your two cats. For one player.
- **Antiaircraft** — Aim and shoot down the enemy airplane. Requires Level I 4K TRS-80. **Order No. 0011R $7.95.**

KNIGHT'S QUEST/ROBOT CHASE/HORSE RACE This varied package of one-player games will give you hours of fun.
- **Knight's Quest** — Battle demons to gain treasure and become a full-fledged knight.
- **Robot Chase** — Destroy the deadly robots without electrocuting yourself.
- **Horse Race** — Place your bet and cheer your horse to the finish line.

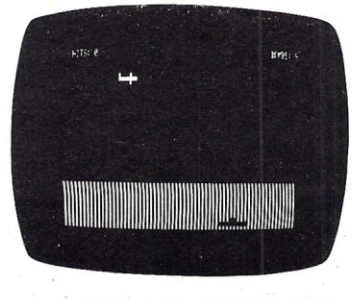
These programs require a TRS-80 Level I 4K. **Order No. 0003R $7.95.**

STATUS OF HOMES/AUTO EXPENSES Two long-awaited programs that have got to save you money at work or in the home:
- **Status of Homes** — This program will allow you to keep track of all the expenses involved in building one house or an entire subdivision.
- **Auto Expenses** — Find out *exactly* what it costs you to drive your car or truck.

These programs require a TRS-80 Level I 4K. **Order No. 0012R $7.95.**

DESTROY ALL SUBS/GUNBOATS/BOMBER This package of three programs is fun for the whole family. Included are:
- **Destroy All Subs** — Hunt down enemy subs while avoiding mines and torpedoes. A one-player game.
- **Gunboats** — Try to blow the enemy's ship out of the water. For one or two players.
- **Bomber** — Carefully release your bomb to destroy the moving submarine. A one-player game.

To enjoy these programs, you'll need a TRS-80 Level I 4K. **Order No. 0021R $7.95.**



Level I

BUSINESS PACKAGE I Keep the books for a small business with your TRS-80 Level I 4K. The six programs included are:
•**General Information** – The instructions for using the package.
•**Fixed Asset Control** – This will give you a list of your fixed assets and term depreciation.
•**Detail Input** – This program lets you create and record your general ledger on tape for fast access.
•**Month and Year to Date Merge** – This program will take your monthly ledger data and give you a year to date ledger.
•**Profit and Loss** – With this program you can quickly get trial balance and profit-and-loss statements.
•**Year-End Balance** – This program will combine all your data from the profit-and-loss statements into a year-end balance sheet.
With this package, you can make your TRS-80 a working partner. **Order No. 0013R $29.95.**

BUSINESS PACKAGE III This package can change your TRS-80 into a full working partner for any businessman:
•**Inventory** – Maintain a computer-based inventory for a constant inventory system.
•**Commissions and Percentages** – Let your computer figure out markup and discount calculations, sales tax and more. This is a perfect time-saving package for any small business.
For the TRS-80 Level I 4K. **Order No. 0061R $7.95.**

DOODLES AND DISPLAYS I Here's a mixed bag of programs that's sure to entertain:
•**Doodle Pad** – Draw pictures and save them on cassette tapes.
•**Symmetrics** – Turn your TRS-80 into a kaleidoscope.
•**Video Display** – Follow the bouncing cursor as your TRS-80 draws its own pictures.
•**Mathcurves** – Bring those geometry lessons to life as the computer draws six different geometrical curves.
•**Rugpatterns** – A never-ending stream of symmetrical patterns that's sure to spark your imagination.
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SPACE TREK III Let yourself go to the far ends of the solar system – and beyond. This package includes:
•**Stellar Wars** – Shoot down the Tie fighters and destroy the Death Star.
•**Planetary Lander** – Land your spacecraft and plant your flag across the solar system.
These one-player games require a TRS-80 Level I 4K. **Order No. 0031R $7.95.**

FUN PACKAGE I Why call it "Fun Package"? Judge for yourself! This entertaining package includes:
•**Rocket Pilot** – Flying it is easy – it's the landing that's tough!
•**Paper, Rock, Scissors** – It's the time-honored game just as you remember it, played against your TRS-80.
•**Hex I** – Just when you master this puzzle game, the computer will increase the difficulty.
•**Missile Attack** – Use your missiles to protect your city from jet attack.
Requires a Level I 16K TRS-80. **Order No. 0037R $7.95.**

TYPING TEACHER This complete seven-part package takes you all the way from initial familiarization with the keys, through typing words and phrases, to complete mastery of the keyboard. Your computer can even become a bottomless page for typing practice. It only requires a TRS-80 Level I 4K. **Order No. 0099R $7.95.**

PERSONAL FINANCE I Let your TRS-80 handle all the tedious details the next time you figure your finances:
•**Personal Finance I** – With this program you can control your incoming and outgoing expenses.
•**Checkbook** – Your TRS-80 can balance your checkbook and keep a detailed list of expenses for tax time.
This handy financial control for the home requires only a TRS-80 Level I 4K. **Order No. 0027R $7.95.**

DEMO I This package is just the thing to show your friends what your TRS-80 can do. Included are:
•**Computer Composer** – Compose and play music using only a standard AM radio.
•**Baseball** – Play baseball with your computer while it does the scorekeeping.
•**Horse Race** – Place your bet and cheer your pony to the winner's circle.
•**ESP** – Test your powers of extrasensory perception.
•**Hi-Lo/Tic-tac-toe** – Guess the secret number or get three in a row.
•**Petals Around the Rose** – Can you figure out the secret behind the five dice?
•**Slot Machine** – Turn your computer into a one-armed bandit. These programs require a TRS-80 Level I 4K. **Order No. 0020R $7.95.**

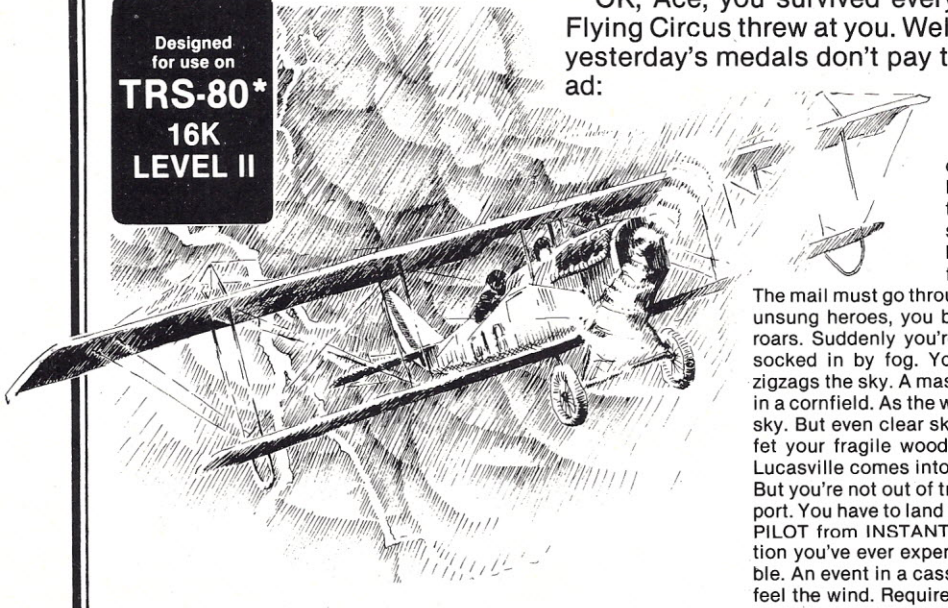
HEXPAWN/SHUTTLE CRAFT DOCKING/SPACE CHASE/SEA BATTLE This four-game package is sure to provide hours of fun for the whole family.
•**Hexpawn** – Turn your TRS-80 into a model of artificial intelligence by playing a simple game.
•**Shuttle Craft Docking** – Land your shuttle craft on the starship – even through varying gravity fields!
•**Space Chase** – Seek out and destroy the enemy delta that's hidden in the star field.
•**Sea Battle** – You must find and destroy the enemy fleet.
This package requires a TRS-80 Level I 16K. **Order No. 0041R $7.95.**

Level II

DEMO II Now get more fun for the bucks with this amazing package.
•**Tic-Tac-Toe** – Play an old-time favorite with three levels of difficulty.
•**Time Trials** – Try to beat the clock as you race your car through curves, chutes, and chicanes.
•**Maze** – One or two players can search through the maze for the secret square.
•**Hangman** – One or two players can try to guess the secret word.
•**Wheel of Fortune** – Choose your number, place your bet, and see if you can break the bank (for one to eight players).
•**Hurricane** – Now you can track and monitor hurricanes anywhere in the world.
•**Bugsy** – Can you build your Z-80 bug before the computer does?
•**Horse Race** – Pick a sure winner and place your bet (for 1 to 100 players).
All you'll need is a TRS-80 Level II 16K. **Order No. 0049R $7.95.**

EVERY FLIGHT IS A SPECIAL DELIVERY

Designed for use on TRS-80* 16K LEVEL II



OK, Ace, you survived everything that von Richthofen and the Flying Circus threw at you. Well, that was four long years ago – and yesterday's medals don't pay the rent. But just a minute, here's an ad:

"Airmail Pilot wanted . . ."

You can almost smell the gasoline as the ground crew fuels your J-4 Jenny biplane to her 26-gallon limit. Precious mail is loaded into the cargo area, tagged for Chicago. The weatherman reports severe icing above 6,000 feet, so you know you have to keep the plane low. It will be a dangerous flight, but you knew that when you took the job. The mail must go through. So, in the tradition of Lindbergh and a hundred unsung heroes, you bravely turn your plane into the wind. The engine roars. Suddenly you're aloft on the first leg of your journey. Dayton's socked in by fog. You change your course for Lucasville. Lightning zigzags the sky. A massive, fast-moving thunderstorm forces you to land in a cornfield. As the weather clears, your plane leaps once more into the sky. But even clear skies can cause problems – violent air currents buffet your fragile wooden aircraft. Your fuel is down to two gallons as Lucasville comes into sight. You make it! Refuel and head for Chicago. But you're not out of trouble yet. There's a wind shear at the Chicago airport. You have to land in a shifting crosswind. Can you make it? AIRMAIL PILOT from INSTANT SOFTWARE. Unlike any other computer simulation you've ever experienced. Challenging. Difficult. But never impossible. An event in a cassette. Crash or fly, it's so realistic, you can almost feel the wind. Requires a Level II 16K. **Order No. 0106R $7.95.**

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Level II

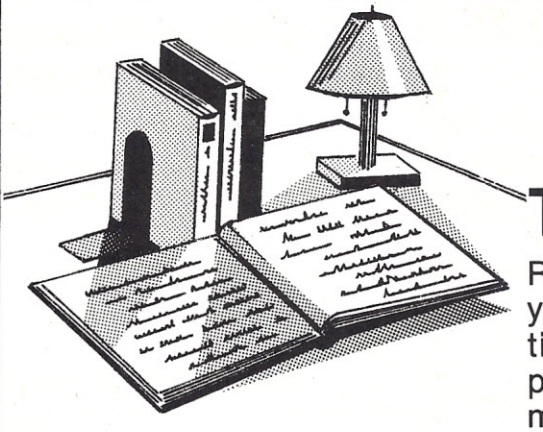
SPACE TREK IV Trade or wage war on a planetary scale. This package includes:
•**Stellar Wars** – Engage and destroy Tie fighters in your attack on the Death Star. For one player.
•**Population Simulation** – A two-player game where you control the economy of two neighboring planets.
You decide, guns or butter, with your TRS-80 Level II 16K. **Order No. 0034R $7.95.**

TRS-80 UTILITY II Let Instant Software change the drudgery of editing your programs into a quick, easy job. Included in this package are:
•**CFETCH** – Search through any Level II program tape and get the file names for all the programs. You can also merge BASIC programs with consecutive line numbers into one program.
•**CWRITE** – Combine subroutines that work in different memory locations into one program. This works with BASIC or machine-language programs and gives you a general checksum.
This package is just the thing for your TRS-80 Level II 16K. **Order No. 0076R $7.95.**

RAMROM PATROL/TIE FIGHTER/KLINGON CAPTURE Buck Rogers never had it so good. Engage in extraterrestrial warfare with:
•**Ramrom Patrol** – Destroy the Ramrom ships before they capture you.
•**Tie Fighter** – Destroy the enemy Tie fighters and become a hero of the rebellion.
• **Klingon Capture** – You must capture the Klingon ship intact. It's you and your TRS-80 Level II 16K battling across the galaxy. **Order No. 0028R $7.95.**

DOODLES AND DISPLAYS II Wait until your children get hold of this package:
•**Doodle Pad** – Draw pictures and save them on cassette tapes.
•**Symmetrics** – An electric kaleidoscope that changes from black to white and back again. It's almost hypnotic!
•**Drawing** – Like Doodle Pad, but for the serious artist. Over 40 user commands!
•**Random Pattern Display** – The computer does the drawing, but those with itchy fingers can tamper.
•**Mathcurves** – Bring those geometry lessons to life. Six different geometrical curves on the screen of your TRS-80.
•**Rugpatterns** – Yes, it does design rug patterns; and with a choice of user or computer control, it can do a whole lot more.
For the Level II 16K TRS-80. **Order No. 0042R $7.95.**

DEMO III This is the biggest package that Instant Software has ever released. Just look at what's included:
•**Race 1** – Careen around the race course as you try to beat the clock.
•**Target UFO** – Destroy all the invading UFOs to rack up a big score.
•**Life** – Experiment with this simulation of the life cycle of a colony of bacteria.
•**Phone Number Converter** – Change those hard-to-remember 7-digit phone numbers into easily remembered words.
•**Biorhythm** – You or your friends can see your biorhythm curves whenever you want.
•**Graphics Program** – This program will really show you what your TRS-80's graphics display can do.
•**Race 2** – Our racing game simulation for the more experienced driver includes a choice of five different tracks.
•**Horse Race** – Up to nine players can bet on and enjoy our most entertaining horse race program.
•**Drawing Board** – Draw pictures or messages and store them in memory or on cassette tape with this easy-to-use program.
•**24-Hour Clock** – Transform your computer into an accurate digital clock.
To enjoy this tremendous value, you'll need a TRS-80 Level II 16K. **Order No. 0055R $7.95.**



Designed for use on TRS-80* 16K LEVEL II

TEACHER

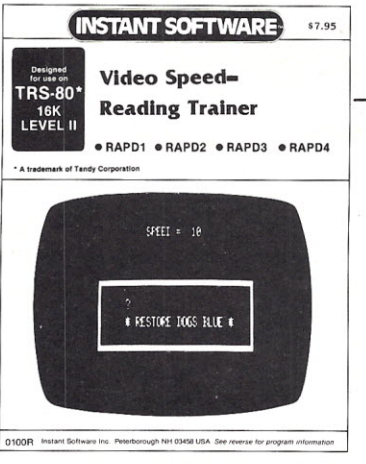
Required to know your lessons verbatim? Here's a tutorial program that will meet your needs.

TEACHER

What do you need to learn? Would you like to know all of the cranial nerves? Electronic color codes? Civil War battles? Signs of the zodiac? Whatever your subject matter, the Teacher package can help you learn it. You simply input up to twenty questions and answers at one time. Next, review the material, and then take the test until you have your lesson down pat. The program gives you up to three hints per question and even offers graphic rewards for children, all at your discretion. All the information can be saved on cassette tape for reuse.

This package also contains the Teacher Data Transfer program, which allows you to combine several tests on one tape. That means you can learn a number of lessons sequentially without changing tapes. Teacher requires a 16K Level II TRS-80. **Order No. 0065R $9.95.**

CARDS This one-player package will let you play cards with your TRS-80 – talk about a poker face!
•**Draw and Stud Poker** – These two programs will keep your game sharp.
•**No-Trump Bridge** – Play this popular game with your computer and develop your strategy.
This package's name says it all. Requires a TRS-80 Level II 16K. **Order No. 0063R $7.95.**



VIDEO SPEED-READING TRAINER As your eyes move along, reading this sentence, do you see the words like t h i s ? Most people's reading speed is limited simply because they read individual letters or words. Now you can increase your reading speed and comprehension, and soon be reading whole words and phrases, with the Video Speed-Reading Trainer package from Instant Software.

Using the same scientific principle as the tachistoscope, a mechanical device used to flash characters or words on a screen, this three-part program will train your mind to quickly recognize numbers, words, letters, and phrases.

The program will take you step by step through a systematic training procedure. You'll start at whatever level of competency you feel is appropriate, and the computer will automatically advance you as your reading speed and comprehension increase. For the Level II 16K TRS-80 Microcomputer. **Order No. 0100R $7.95.**

HOUSEHOLD ACCOUNTANT Let your TRS-80 help you out with many of your daily household calculations. Save time and money with these fine programs:
•**Budget and Expense Analysis** – You can change budgeting into a more pleasant job with this program. With nine sections for income and expenses and the option for one- and three-month review or year totals, you can see where your money is going.
•**Life Insurance Cost Comparison** – Compare the costs of various life insurance policies. Find out the difference in price between term and whole life. This program can store and display up to six different results.
All you need is TRS-80 Level II 16K. **Order No. 0069R $7.95.**

FINANCIAL ASSISTANT Compute the figures for a wide variety of business needs. Included are:
•**Depreciation** – This program lets you figure depreciation on equipment in five different ways.
•**Loan Amortization Schedule** – Merely enter a few essential factors, and your TRS-80 will display a complete breakdown of all costs and schedules of payment for any loan.
•**Financier** – This program performs thirteen common financial calculations. Easily handles calculations on investments, depreciation, and loans.
•**1% Forecasting** – Use this simple program to forecast sales, expenses, or any other historical data series.
All you need is a TRS-80 Level II 16K. **Order No. 0072R $7.95.**

MODEL ROCKET ANALYZER AND PRE-FLIGHT CHECK Let your TRS-80 help you enjoy the fast-growing hobby of model rocketry. The complementary programs included are:
•**Model Rocket Flight History Prediction** – This program will compute the flight characteristics for almost any model rocket. Engine and body tube data included covers Estes, Centuri, Flight Systems, A.V.I. Astroport, C.M.R., and Kopter products.
•**Weather Forecaster** – Before you launch your rocket, get an up-to-the-minute weather forecast. Just enter your location, elevation, average temperatures for January and July, and barometric pressure. You'll be the short-range weather forecaster for your area.
For a successful launch, you'll need TRS-80 Level II 16K. **Order No. 0024R $7.95.**

Level II

SANTA PARAVIA AND FIUMACCIO
Become the ruler of a medieval city-state as you struggle to create a kingdom. Up to six players can compete to see who will become the King or Queen first. This program requires a TRS-80 Level I or II 16K. **Order No. 0043R $7.95.**

TRS-80 UTILITY II Let Instant Software change the drudgery of editing your programs into a quick, easy job. Included in this package are:
•**CFETCH** – Search through any Level II program tape and get the file names for all the programs. You can also merge BASIC programs with consecutive line numbers into one program.
•**CWRITE** – Combine subroutines that work in different memory locations into one program. This works with BASIC or machine-language programs and gives you a general checksum.
This package is just the thing for your TRS-80 Level II 16K. **Order No. 0076R $7.95.**

SPACE TREK IV Trade or wage war on a planetary scale. This package includes:
•**Stellar Wars** – Engage and destroy Tie fighters in your attack on the Death Star. For one player.
•**Population Simulation** – A two-player game where you control the economy of two neighboring planets.
You decide, guns or butter, with your TRS-80 Level II 16K. **Order No. 0034R $7.95.**

PERSONAL BILL PAYING

NOTE: This package can take the headaches and/or penalties out of paying your bills.

In a business office the accounts payable (bills) are usually paid on or immediately before their due date. That way, the payer gets the fullest use of his money without incurring penalties for being behind in paying his debts. Now you can take advantage of this system for your monthly bills, letting your TRS-80 do all the drudgery and record keeping.

This useful package provides a computerized list of all your bills and payments. You can access as many as 22 accounts, all of which can be named – up to 15 characters per name. Each account is listed by number, amount owed, due date, and present activity.

Don't confuse this system with a "checkbook" program. The functions of this package are threefold: (1) to monitor your bills; (2) to order payments most effectively; and (3) to make historical comparisons of individual accounts or specific months.

After you load the program, it displays a menu of 11 activities. They include:
Build and Maintain Files
List All Accounts
List Current Accounts
Make Payment(s) to Account
Enter New Bill to Account
Display Payment History of Individual Account (includes date paid, check number, and 12-month total)
Display Payment History of Selected Month
Delete Account
Delete Prior Month's Payment
Save File on Tape
Input File from Tape

After you have updated the records by entering new bills, paying bills, or changing the accounts, you can save all the information on data tape. This data tape will then be input for the next time you use the package. Maybe it can't make paying bills all fun and games, but it should relieve some of the agony. Level II 16K required. **Order No. 0103R $7.95.**

PET**

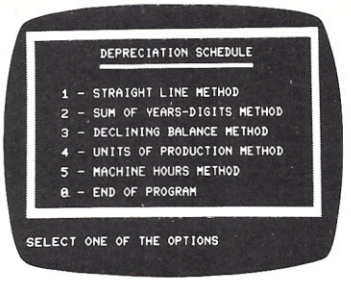
PERSONAL WEIGHT CONTROL/BIORHYTHMS Let your PET help take care of your personal health and safety:
•**Personal Weight Control** – Your PET will not only calculate your ideal weight, but also offer a detailed diet to help control your caloric intake.
•**Biorhythms** – Find out when your critical days are for physical, emotional, and intellectual cycles.
You'll need only a PET with 8K memory. **Order No. 0005P $7.95.**

CASINO I These two programs are so good, you can use them to check out and debug your own gambling system!
•**Roulette** – Pick your number and place your bet with the computer version of this casino game. For one player.
•**Blackjack** – Try out this version of the popular card game before you go out and risk your money on your own "surefire" system. For one player.
This package requires a PET with 8K. **Order No. 0014P $7.95.**

MORTGAGE WITH PREPAYMENT OPTION/FINANCIER These two programs will more than pay for themselves if you mortgage a home or make investments:
•**Mortgage with Prepayment Option** – Calculate mortgage payment schedules and save money with prepayments.
•**Financier** – Calculate which investment will pay you the most, figure annual depreciation, and compute the cost of borrowing, *easily and quickly*.
All you need to become a financial wizard with an 8K PET. **Order No. 0006P $7.95.**

CASINO II This craps program is so good, it's the next best thing to being in Las Vegas or Atlantic City. It will not only play the game with you, but will also teach you how to play the odds and make the best bets. A one-player game, it requires a PET 8K. **Order No. 0015P $7.95.**

ARCADE I This package combines an exciting outdoor sport with one of America's most popular indoor sports:
•**Kite Fight** – It's a national sport in India. After you and a friend have spent several hours maneuvering your kites across the screen of your PET, you'll know why!
•**Pinball** – By far the finest use of the PET's exceptional graphics capabilities we've ever seen, and a heck of a lot of fun to boot.
Requires an 8K PET. **Order No. 0074P $7.95.**



ACCOUNTING ASSISTANT This package will help any businessman solve many of those day-to-day financial problems. Included are:
•**Loan Amortization Schedule** – This program will give you a complete breakdown of any loan or investment. All you do is enter the principal amount, interest rate, term of the loan or investment, and the number of payments per year. You see a month-by-month list of the principal, interest, total amount paid, and the remaining balance.
•**Depreciation Schedule** – You can get a depreciation schedule using any one of the following methods: straight line, sum of years-digits, declining balance, units of production, or machine hours. Your computer will display a list of the item's lifespan, the annual depreciation, the accumulated depreciation, and the remaining book value. This package requires the PET 8K. **Order No. 0048P $7.95.**

ARCADE II One challenging memory game and two fast-paced action games make this one package the whole family will enjoy for some time to come. Package includes:
•**UFO** – Catch the elusive UFO before it hits the ground!
•**Hit** – Better than a skeet shoot. The target remains stationary, but you're moving all over the place.
•**Blockade** – A two-player game that combines strategy and fast reflexes.
Requires 8K PET. **Order No. 0045P $7.95.**

DUNGEON OF DEATH Battle evil demons, cast magic spells, and accumulate great wealth as you search for the Holy Grail. You'll have to descend into the Dungeon of Death and grope through the suffocating darkness. If you survive, glory and treasure are yours. For the PET 8K. **Order No. 0064P $7.95.**

BASEBALL MANAGER This pair of programs will let you keep statistics on each of your players. Obtain batting, on-base, and fielding averages at the touch of a finger. Data can be easily stored on cassette tape for later comparison. All you need is a PET with 8K. **Order No. 0062P $14.95.**

PENNY ARCADE Enjoy this fun-filled package that's as much fun as a real penny arcade – at a fraction of the cost!
•**Poetry** – Compose free verse poetry on your computer.
•**Trap** – Control two moving lines at once and test your coordination.
•**Poker** – Play five-card draw poker and let your PET deal and keep score.
•**Solitaire** – Don't bother to deal, let your PET handle the cards in this "old favorite" card game.
•**Eat-Em-Ups** – Find out how many stars your Gobbler can eat up before the game is over.
These six programs require the PET with 8K. **Order No. 0044P $7.95.**

MIMIC Test your memory and reflexes with the five different versions of this game. You must match the sequence and location of signals displayed by your PET. This one-player program includes optional sound effects with the PET 8K. **Order No. 0039P $7.95.**

DECORATOR'S ASSISTANT This integrated set of five programs will compute the amount of materials needed to redecorate any room, and their cost. All you do is enter the room dimensions, the number of windows and doors, and the base cost of the materials. These programs can handle wallpaper, paint, panelling, and carpeting, letting you compare the cost of different finishing materials. All you'll need is a PET 8K. **Order No. 0104P $7.95.**

TREK-X Command the Enterprise as you scour the quadrant for enemy warships. This package not only has superb graphics, but also includes programming for optional sound effects. A one-player game for the PET 8K. **Order No. 0032P $7.95.**

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PET**

DIGITAL CLOCK Don't let your PET sit idle when you are not programming—put it to work with these two unique and useful programs:
•**Digital Clock**—Turn you PET into an extremely accurate timepiece that you can use to display local time and time in distant zones, or as a split-time clock for up to nine different sporting events.
•**Moving Sign**—Let the world know what's on your mind. This program turns your PET into a flashing graphic display that will put your message across. **Order No. 0083P $7.95.**

TURF AND TARGET Whether on the field or in the air, you'll have fun with the Turf and Target package. Included are:
•**Quarterback**—You're the quarterback as you try to get the pigskin over the goal line. You can pass, punt, hand off, and see the result of your play with the PET's superb graphics.
•**Soccer II**—Play the fast-action game of soccer with four playing options. The computer can play itself or a single player; two can play with computer assistance, or two can play without help.
•**Shoot**—You're the hunter as you try to shoot the bird out of the air. The PET will keep score.
•**Target**—Use the numeric keypad to shoot your puck into the home position as fast as you can.
To run and score, all you'll need is a PET with 8K. **Order No. 0097P $7.95.**

TANGLE/SUPERTRAP These two programs require fast reflexes and a good eye for angles:
•**Tangle**—Make your opponent crash his line into an obstacle.
•**Supertrap**—This program is an advanced version of Tangle with many user control options.
Enjoy these exciting and graphically beautiful programs. For one or two players with an 8K PET. **Order No. 0029P $7.95.**

CHECKERS/BACCARAT Play two old favorites with your PET.
•**Checkers**—Let your PET be your ever-ready opponent in this computer-based checkers program.
•**Baccarat**—You have both Casino- and Black-jack-style games in this realistic program.
Your PET with 8K will offer challenging play anytime you want. **Order No. 0022P $7.95.**

DOW JONES Up to six players can enjoy this exciting stock market game. You can buy and sell stock in response to changing market conditions. Get a taste of what playing the market is all about. Requires a PET with 8K. **Order No. 0026P $7.95.**

Apple***

GOLF Without leaving the comfort of your chair, you can enjoy a computerized 18 holes of golf with a complete choice of clubs and shooting angles. You need never cancel this game because of rain. One or two players can enjoy this game on the Apple with Applesoft II and 20K. **Order No. 0018A $7.95.**

BOWLING/TRILOGY Enjoy two of America's favorite games transformed into programs for your Apple:
•**Bowling**—Up to four players can bowl while the Apple sets up the pins and keeps score. Requires Applesoft II.
•**Trilogy**—This program can be anything from a simple game of tic-tac-toe to an exercise in deductive logic. For one player.
This fun-filled package requires an Apple with 20K. **Order No. 0040A $7.95.**

MATH TUTOR I Parents, teachers, students, now you can turn your Apple computer into a mathematics tutor. Your children or students can begin to enjoy their math lessons with these programs:
•**Hanging**—Perfect your skill with decimal numbers while you try to cheat the hangman.
•**Spellbinder**—Cast spells against a competing magician as you practice working with fractions.
•**Whole Space**—While you exercise your skill at using whole numbers, your ship attacks the enemy planet and destroys alien spacecraft.
All programs have varying levels of difficulty. All you need is Applesoft II with your Apple II 24K. **Order No. 0073A $7.95**

MORTGAGE WITH PREPAYMENT OPTION/FINANCIER (see description for PET version 0006P) This package requires the Apple 16K. **Order No. 0094A $7.95.**

ACCOUNTING ASSISTANT (see the description for the PET version 0048P) This package requires the Apple 16K. **Order No. 0088A $7.95.**

MIMIC (see description for the PET version 0039P) This package requires the Apple 24K. **Order No. 0025A $7.95.**

MATH TUTOR II Your Apple computer can go beyond game playing and become a mathematics tutor for your children. Using the technique of immediate positive reinforcement, you can make math fun with:
•**Car Jump**—Reinforce the concept of calculating area while having fun making your car jump over the ramps.
•**Robot Duel**—Practice figuring volumes of various containers while your robot fights against the computer's mechanical man.
•**Sub Attack**—Take the mystery out of working with percentages as your submarine sneaks into the harbor and destroys the enemy fleet.
All you need is Applesoft II with your Apple II and 20K. **Order No. 0098A $7.95.**

HEATH****

MENTAL GYMNASTICS Pit your mind against the challenge of these ancient games:
•**Reversi**—As you and a friend or the computer place your pieces on the board, you must each try to capture your opponent's pieces. The score can fluctuate wildly, and nobody can tell who'll win until the last move.
•**Wari**—You can play a friend or the computer in this simple yet intriguing game. The two players take turns removing pieces from one cup and placing them in the other cups. As play continues, the number of pieces decreases. The last player who has a piece to move wins the game.
To enjoy these ageless games, you'll need the Heath H-8 with 8K. **Order No. 0087H $7.95.**

DATA TAPES Use these high-quality leaderless data tapes to record business or personal data. Four tapes per package. **Order No. 0067 $7.95.**

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**An trademark of Commodore Business Machines, Inc.
***A trademark of Apple Computer, Inc.
****A trademark of the HEATH Company

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Peterborough, N.H. 03458 USA

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Computerland of Huntsville
3020 University Dr., Huntsville

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3763 Airport Blvd., Mobile

Arizona

Ham Shack
450 6-A N. 16th St., Phoenix

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621 East Broadway, Mesa

Resalem Electronics
16610 Meadow Park Dr., Sun City

California

Amco Elect. Supply
635 E. Arrow Hwy., Azusa

Byte Shop of Fairfield
87 Marina Center St., Suisun City

Byte Shop of Mt. View
1415 West El Camino Real, Mt. View

Byte Shop of Sacramento
6041 Greenback Ln., Citrus Heights

Capital Computer Systems
3396 El Camino Ave., Sacramento

Computer Components of Burbank
3808 West Verdugo Ave., Burbank

Computer Components of South Bay
15818 Hawthorne Blvd., Lawndale

Computers Made Easy
819 East Ave. Q-9, Palmdale

Computer World
6791 Westminster Ave., Westminster

Computerland
16720 S. Hawthorne, Lawndale

Computerland of San Francisco
117 Fremont St., San Francisco

Computerland of W. LA
6840 La Cienega Blvd., Inglewood

Coast Electronics
3118 No. Main St., Morro Bay

Hobby World
19511 Business Ctr. Dr., Unit 6
Borthridge

I.C.E. House Inc.
398 North E. St., San Bernardino

Marfam Co.
6351 Almadin Rd., San Jose

Microsun Computer Center
2989 North Main St., Walnut Creek

Opamp/Technical Books
1033 N. Sycamore Ave., Los Angeles

Radio Shack Dealer
8250 Mira Mesa Blvd., San Diego

Santa Rosa Computer Center
604 7th St., Santa Rosa

Silver Spur Elect. Comm.
3873 F. Shaefer Ave., Chino

The Computer Store
820 Broadway, Santa Monica

Colorado

Byte Shop
3464 S. Acoma St., Englewood

Colorado Computer Systems
311 W. 74th Ave., Westminster

Computerland of North Denver
8749 Wadsworth Blvd., Arvada

The Computer Store
2300 Welton St., Denver

Connecticut

American Business Computers
Rt. 184 & Rt. 117, Groton

Computerlab
130 Jefferson, New London

The Computer Store
43 South Main St., Windsor Locks

D.C.

The Program Store
4200 Wisconsin Ave., N.W.,
Washington, D.C.

Florida

Adventure International
200 Bald Cypress Ct., Longwood

Alvorado Export
8525 NW 56th St., Miami

AMF Electronics
11146 N. 30th St., Tampa

Boyd-Ebert Corporation
1328 West 15th St., Panama City

Computer Center
6578 Central Ave., St. Petersburg

Computerland of Boca Raton
500 E. Spanish River Blvd.
Boca Raton

Computerland of Ft. Lauderdale
3963 N. Federal Hwy., Ft. Lauderdale

Computerland of Jacksonville
2777-6 University Blvd. W.,
Jacksonville

Computer Shack
3336 Beach Blvd., Jacksonville

Curtis Waters Enterprises
236 Talbot Ave., Melbourne

Heath Kit Electronic
4705 W. 16th Ave. Center, Hialeah

Sound Ideas
2201-C N.W. 13th, Gainesville

Ukatan Computer Store
Airport Rd., Destin

Georgia

Atlanta Computer Mart
Atlanta

Computerland of Atlanta
2423 Cobb Parkway, Smyrna

Hawaii

Computerland of Hawaii
567 N. Federal Hwy., Honolulu

Radio Shack Assoc. Store
1712 S. King St., Honolulu

Idaho

Electronic Specialists
8411 Fairview Ave., Boise

Illinois

Bloomington Normal Computer
Works
124 E. Beaufort, Normal

Computer Station
3659 Nameoki Rd., Granite City

Midwest Micro Computers, Inc.
708 S. Main St., Lombard

Indiana

Computer Center of South Bend
51591 US 31 North, South Bend

Iowa

Cyberia, Inc.
2330 Lincoln Way, Ames

Memory Bank
4128 Brady St., Davenport

Kansas

Central Kansas Computers
6 S. Broadway, Herington

Louisiana

Computer Shoppe Inc.
3225 Danny Park, Suite 222, Metairie

Maine

Radio Shack
315 Main Mall Rd., So. Portland

Maryland

Computers, Etc.
13 A. Allegheny Ave., Towson

Jack Fives Electronics
4608 Debilen Circle, Pikesville

The Comm Center
9624 Ft. Meade Rd., Laurel

Massachusetts

ComputerCity
5 Dexter Row, Charlestown

Computer Packages Unlimited
244 W. Boylston St., West Boylston

Lighthouse Computer Software
14 Fall River Ave., Rehobath

New England Electronics Co.
679 Highland Ave., Needham

The Computer Store
120 Cambridge St., Burlington

Tufts Radio & Electronics
206 Mystic Ave., Medford

Michigan

Computer Center
28251 Ford Rd., Garden City

Computer Connections
38437 Grand River, Farmington Hills

Computerland of Grand Rapids
2927 28th St. S.E., Kentwood

Computerland of Rochester
301 S. Livernois, Rochester

Computerland of Southfield
29673 Northwestern Hwy., Southfield

Computer Mart
560 W. 14 Mile Rd., Clawson

Golden Anvil
259 Broadway, South Haven

Hobby House
1035 W. Territorial Rd., Battle Creek

Minnesota

Zim Computers
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Computervan, Inc.
51 Florissant Oaks Shopping Center,
Florissant

Consolidated Software
16501 Greenwald Court, Belton

Montana

Intermountain Computer
529 So. 9th St., Livingston

The Computer Store
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Nebraska

Computerland of Omaha
11031 Elm St., Omaha

Midwest Computer Co. Inc.
8625 I St., Omaha

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4442 S. 84th St., Omaha

Midwest Computer Co. Inc.
4403 S. 87th St., Omaha

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4566 Spring Mountain Rd., Las Vegas

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1775 Tropicana #2, Las Vegas

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1525 S. Willow, Manchester

Computerland of Nashua
419 Amherst St., Nashua

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31 Raynes Ave., Portsmouth

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Rt. 57 Allen Rd., Hackettstown

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Comtek Electronics, Inc.
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Softron Systems
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5313 Bissonet, Bell Aire

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9090 Stemmons Frwy., Dallas

Pan American Elect. Inc.
1117 Conway, Mission

Ram Micro Systems
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Reb's Mail Order Electronics
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Tamays & Farr Ltd.
4 Morgan St., London

France

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20, Rue de Leningrad, Paris

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Improved Video DMA for the CT-64

This follow-up to an Oct. 79 article by the same author adds circuitry for 64 × 64 graphics.

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In a previous article ("Video DMA Interface for SWTP Systems," p.88, *Microcomputing*, October 1979), my coauthor, Jerry Boehme, and I described the circuitry necessary for giving the computer direct access to the display memory for an SWTP 6800 computer and CT-64 terminal. This gives a memory-mapped display, with each character position on the screen corresponding to a specific location in display (computer) memory. Producing simple or exotic displays is extremely rapid with operation at the computer program execution rate rather than at the slow computer/terminal external transfer rate. We presented some simple programs in order to demonstrate this capability.

Limited raster scan graphics result directly from the design, since 16 × 64 resolution can be achieved by programming a blank (space) or mark (highlighted space) at each character position. Bit 7 determines whether a normal or highlighted space (or any character) is displayed (we number the eight data bits 0–7). While the 64 position resolution in the horizontal direction is OK, the 16 position per column resolution in the vertical direction is not very satisfactory. The simple circuitry described in this article increases the resolution by a factor of 4 in the vertical direction. Each character position on the 16 × 64 grid is broken up into four smaller pieces vertically.

You will see that for any display, this gives 16 possible combinations for these four resolution elements to be on or off, depending on the status of the four lowest-order bits in the corresponding 8-bit memory word. This resolution is more than adequate for many applications, for example, computer games. Bit 7 is now used to determine whether a specific location is for a graphic or alphanumeric character.

This inherent mixed graphic-alphanumeric mode is useful for plots with labeled axes, score-keeping or counting in computer games. We present a driver and demonstration program, leaving the development of software for more specific applications to the reader.

No additional memory is required. Memory that was purchased with the terminal was used. In fact, you can use the following simple circuit to increase graphics resolution and experiment with limited raster scan graphics without using the video DMA circuitry. However, a substantial amount of control and speed in creating displays will be lost. Before we describe the circuitry involved in the present design, we should take a closer look at how the CT-64, or practically any terminal, will produce the video display character.

The Character Generator Display

Fig. 1 presents a schematic of some basic circuitry necessary for the generation and shifting out of video data to the TV or monitor. As shown in Fig. 2, each of the 16 × 64 character positions comprises an 8 by 13 matrix of dots. It is the function of the character generator and associated circuitry to take the appropriate 8-bit display memory word and convert it into the proper combination of blanks (0) or lit (1) dots to produce the display character.

As shown in Fig. 2, each character position has 13 horizontal rows to a line and also eight vertical columns. The terminal has counters to keep track of which of the 64 characters (or 32 in that mode) per display line, as well as which of the 16 lines, is being displayed. These counters maintain synchrony with the terminal horizontal and vertical sync pulses as well as other display memory address circuitry. As the memory is being addressed, the appropriate 7-bit word (bits 0 to 6) is presented to the character generator. Bit 7 is directed to another circuit for character highlighting (or graphics).

The CT-64 uses the Motorola 6575L character generator having uppercase, lowercase and control characters; 128 in all are available. For any screen posi-

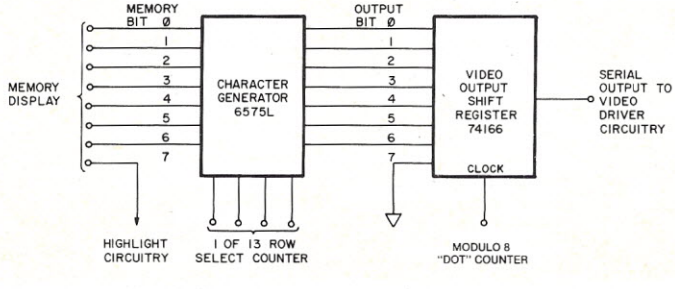


Fig. 1. The CT-64 character display circuitry.

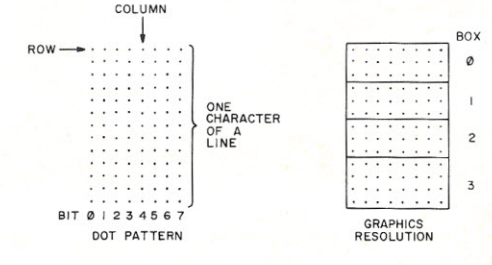


Fig. 2. Dot pattern definitions for one screen position and the position breakdown for increased graphics resolution.

tion, the 7-bit input memory word selects one of these characters for output. For each of the 13 rows in a character position, the four character-generator row-select inputs cause the proper 7-bit word to be *output* by the character generator to the video output shift register. Actually, only a 7 × 9 matrix is used for any one character. The four bottom rows of a position are either blanked for spacing between character lines or used for descending, lowercase letters. A blank vertical column between characters is achieved by grounding the bit-7 input to the shift register; this bit is shifted out last as shown in Fig. 2. A modulo 8 dot counter synchronized with the horizontal sync pulses causes the eight bits-per-character row to be shifted out to the video output driver circuitry.

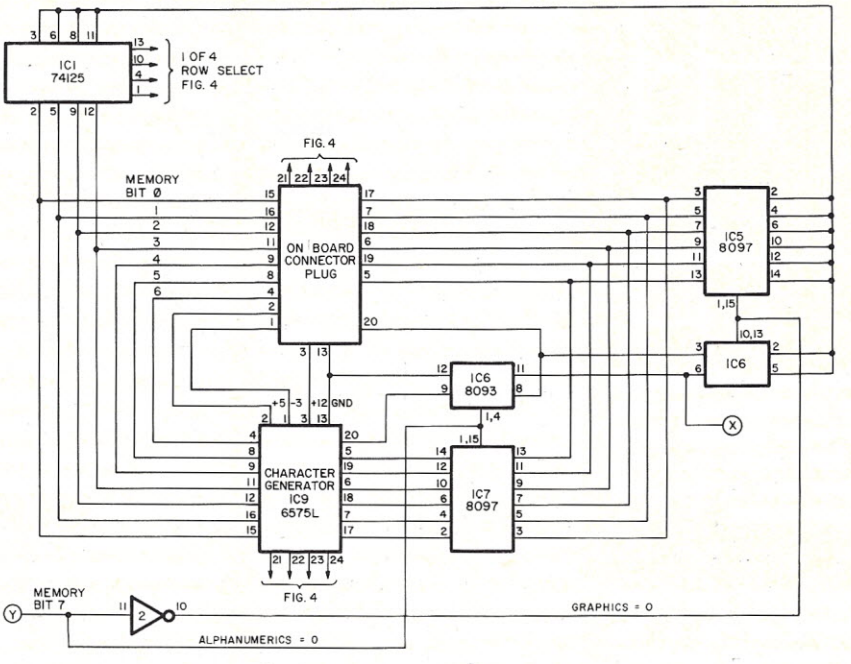


Fig. 3. Graphics board schematic. Connections are made to the main terminal board at the old character generator socket via the 24-pin wire-wrap socket on the graphics board. The four row-select lines are derived from Fig. 4, while connections X and Y are obtained from the main terminal board according to Fig. 5.

As the terminal and TV sweep line by line, new 7-bit words are presented to the shift register by the character generator and shifted out. Note that for each character position the same 7-bit memory word is presented to the character generator inputs for 13 row scans necessary to generate the character line. The 1 of 13 decoding is taken care of by the character generator row select inputs, fed by one of the counters mentioned above.

Examples of possible modifications to this circuitry will aid in understanding its operation. Refer to Fig. 1 and the dot patterns of Fig. 2. Assume that the character generator has been removed, so that we can have access to the shift register inputs. Suppose we lift the shift register bit-7 input from ground, allowing this input to go high. This would result in vertical white lines on the screen at the bit-7 positions of all character positions. Similarly, white or dark (blank) vertical lines or groups of lines result from holding other shift register inputs high or low. This operation presents possibilities for increasing graphics resolution in the horizontal direction.

Consider now using the 13-row-per-character resolution in the vertical direction. What would happen if we tied *all* of the shift register inputs together? Referring to Fig. 2, you can see that this would cause the status of the eight dots per horizontal row to be the same for any particular row. You can envisage circuitry using the eight memory word bits along with the four row-select lines to determine the status of this common shift register input per 13 rows, thus increasing resolution in the vertical direction.

Since we have eight bits per word, we have the possibility of increasing the resolution in the vertical direction by a factor of 8, the resolution elements being one or two rows of eight horizontal dots (rectangles). This arrangement requires no additional memory.

It turns out that bits 4–6 are further decoded by the CT-64 for selection of uppercase, lowercase and control character printing, making it less convenient to use these bits for increased graphics resolution without additional modifications of the terminal. We therefore chose to use the four lowest-order bits per character word to determine the status of the common shift register input per 13 character rows in the graphic mode. As we will see shortly, bit 7 is used to choose between graphics circuitry or character generator feeding the video output shift register.

The Graphics Circuitry

Figs. 3 and 4 present the graphics circuitry, based on the concepts just presented. The entire circuit is mounted on a small board, approximately 8 cm × 8 cm, which is plugged into the CT-64 at the character generator location via a 24-pin wire-wrap socket (long leads) mounted on the graphics board. The leads from this socket comprise the male half (plug) of the connector.

The character generator (terminal IC22) is first removed from the main terminal board and replaced with another 24-pin socket, used as the female connector half. We use a wire-wrap socket for this purpose also, since they are more sturdy than low-profile sockets and stand up better to insertion and removal of the graphics board connector during debugging.

The outputs of noninverting Tri-state buffers ICs 5–7 make the eight video shift register inputs, via the connector plug, lie

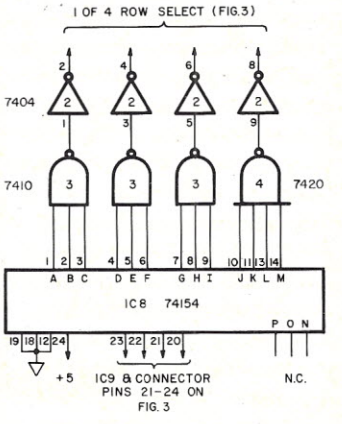


Fig. 4. Graphics board row-select circuitry. The extra connections refer to Fig. 3.

along a common bus, which can be accessed by either the character generator or the graphics circuitry outputs. Access of only one of these devices is ensured by the low (alphanumeric) or high (graphic) state of memory word bit 7 and the complementary status of inverter IC2 (pin 10). These complementary signals are routed to the Tri-state enable inputs of ICs 5–7. The 7-bit memory words are continually presented to the graphics circuitry and character generator, so the output to the video shift register for any screen position will be

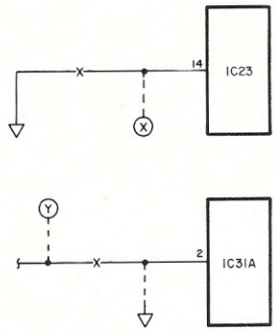


Fig. 5. Main terminal board modifications showing jumper connections to the graphics board points X and Y as per Fig. 3. The IC numbers refer to the CT-64 main terminal board.

determined by bit 7 and the Tri-state devices of Fig. 3. The graphics words are generated as follows.

The four lowest-order bits of the corresponding memory words are presented to the inputs of Tri-state buffer IC1. The outputs of IC1 are wire-ORed and tied to the inputs of IC5 and 1/2 IC6. The eight outputs of these devices are presented, via the connector plug, to the video output shift register and are shifted out to give white or blank 8-dot rows in the graphic mode (memory word bit 7 high). Which rows are white is determined by the four lowest-order memory bits and the new 1 of 4 row-select lines. This row-select sequence is generated by the circuit of Fig. 4.

The BCD (1 of 13) row-select lines normally connected to the character generator are routed *also* to the BCD inputs of 1 of 16 data selector IC8. This, in conjunction with 3-input NAND and 4-input NAND gates IC3 and 4 and inverters IC2, converts the 1 of 13 to a 1 of 4 row-select circuit. Only one output of IC8 at a time is low.

When you consider the truth table for ICs 2 to 4, you find that only one output of the four inverters of IC2 at a time will be low. This causes only one Tri-state buffer of IC1 to be activated at a time, thus passing the status of the appropriate memory bit to the shift register inputs in the graphic mode. Thus, bit 0 determines the status of the first three 8-dot rows, bit 1 for rows 3 to 5, bit 2 for rows 6 to 8 and bit 3 for rows 9 to 12. The effect is to break each character position into three 3-row by 8-dot rectangles and one 4-row by 8-dot rectangle. Of course, the 8-dot direction is the horizontal.

Fig. 2 shows the result for any screen position. Since four memory bits are used, this gives sixteen possible combinations of blank or white rectangles per screen position in the graphic mode. For instance, ASCII code A1 (i.e., ASCII 21 with bit 7 = 1) in a particular display memory location yields a white rectangle comprising the upper three rows of the corresponding screen position. An A8 would cause a rectangle made up of the lowest four rows to be lit, with AF giving an entire 13-row white position. Examination of the ASCII to hex conversion table shows that several different codes can be used to give the same result. Table 1 gives the power connections for the circuitry of Figs. 3 and 4.

Only two small modifications to the main terminal board are necessary. Refer to Figs. 3 and 5 points (X) and (Y). Pin 14 of terminal board IC23 must be removed from ground and jumpered to graphics board point (X) connections. This is the bit-7 input of the serial shift register. The second modification involves cutting the foil going to terminal IC31A, pin 2. Examination of the CT-64 board layout shows a convenient place on the top of the main terminal board. Pin 2 of IC31A should be grounded. The former input should be jumpered to graphics board point (Y) connections. This is the bit-7 memory data line used to determine alphanumeric or graphic modes.

A point about this particular graphics circuit should be mentioned. Originally, two 74157 quad 1 of 2 data selectors were used in place of Tri-state buffers ICs 5-7 to select between graphic or alphanumeric outputs. But this resulted in distorted, poorly resolved alphanumerics. This was not a problem with the Tri-state devices.

Examination of the CT-64 documentation and schematics shows that a switch can be attached to the bit-7 input to the terminal serial interface on the keyboard side of the UART. If bit 7 is set high (+5 V) with the switch, then typing on the keyboard results in the printing of the corresponding graphic characters, as defined by the ASCII codes output by the keyboard encoder. Similarly, switching bit 7 to ground gives normal alphanumeric characters on keyboard entry.

In either case, computer-generated memory words will be alphanumeric or graphic depending on the status of bit 7 of the computer memory word. Thus, graphics displays can be obtained using the keyboard-generated cursor movements and graphic character entry at the desired screen locations. This is helpful in getting a feel for the operation of the circuitry. Furthermore, if the video DMA circuitry has been incorporated (see " A Video DMA Interface"), standard graphic screens generated in this way can be saved rapidly on tape or disk by simply dumping the contents of display memory onto the mass storage medium with standard system software.

Software

Listing 1 presents a BASIC program that can be used for turning on or off any one of the 64 × 64 resolution elements without affecting the status of other screen positions. The actual display driver subroutine begins at line 1000 and uses concepts presented by David Koh ("Raster Scan Graphics for the 6800," *Kilobaud*, December 1978 p. 56). The subroutine requires input of the variables H and V for the horizontal and vertical coordinates, as well as the variable Z, with Z = 1 for a mark and Z = 0 for a blank position. The upper left-hand screen position corresponds to (H,V) = (0,0).

With our version of BASIC, the program is a bit slow due to the byte unpack and pack routines and the POKE command requiring decimal to hexadecimal conversion. Machine-language programs would be much faster, but the computation power of BASIC would not be readily available.

IC	Type	+ 5 (a)	GND(b)
1	DM8093(c)	14	7
2	7404	14	7
3	7410	14	7
4	7420	14	7
5	DM8097(d)	16	8
6	DM8093	14	7,12
7	DM8097	16	8
8	74154	24	12,18,19
9	6575L	2	13

(a) Derived from connector pin 2

(b) Derived from connector pin 13.

(c) Equivalent to 74125.

(d) Equivalent to 74367.

Table 1. Power supply connections.

Listing 1.

```
0001 REM GRAPHICS DRIVER
0005 PRINT CHR$(01),CHR$(01)
0050  Z=1
0055 REM DEMONSTRATION
0060 FOR V=0 TO 63
0070  H=V:GOSUB 1010
0080  V=63-V:GOSUB 1010
0085  V=63-V
0090 NEXT V
0100 END
1000 REM GRAPHICS DRIVER
1002 REM NEEDS (V)ERT, (H)ORZ COORDS
1003 REM AND Z=1 (MARK) OR Z=0 (BLANK)
1005 REM (L)INE=0 TO 15
1006 REM (R)OW=0 TO 3 PER LINE
1010  L1=V/4:L=INT(L1):R=4*(L1-L)
1020  M=24576 +64*L+V:REM PAGE 1 LOCN
1030  C=PEEK(M):REM (C)ONTENTS
1040 REM UNPACK BYTE
1050  B7=0:IF C>127 THEN B7=1:C=C-128
1060  B6=0:IF C>63 THEN B6=1:C=C-64
```

```
1070  B5=0:IF C>31 THEN B5=1:C=C-32
1080  B4=0:IF C>15 THEN B4=1:C=C-16
1090  B3=0:IF C>7 THEN B3=1:C=C-8
1100  B2=9:IF C>3 THEN B2=1:C=C-4
1110  B1=0:IF C>1 THEN B1=1:C=C+2
1120  B0=0:IF C>0 THEN B0=0
1160 ON R+1 GOTO 1180,1190,1200,1210
1170 REM REBUILD
1180  B0=Z:GOTO 1220
1190  B1=Z:GOTO 1220
1200  B2=Z:GOTO 1220
1210  B3=Z
1220  C=0
1230 IF B0=1 THEN C=C+1
1240 IF B1=1 THEN C=C+2
1250 IF B2=1 THEN C=C+4
1260 IF B3=1 THEN C=C+8
1270 IF B4=1 THEN C=C=16
1280 IF B5=1 THEN C=C+32
1290 IF B6=1 THEN C=C+64
1300 IF B7=1 THEN C=C+128
1310 POKE( M,C):REM REPLACE
1320 RETURN
```

Line 5 clears the page through a control character function, with the CT-64 CTRLA pad connected to the INIT pad. The subroutine program beginning at line 50 draws lines of slope 1 and −1 to demonstrate the operation of the circuitry.

Summary

We have presented extremely simple circuitry for increasing the graphics resolution of your terminal to 64 × 64. This is more than adequate for many applications and offers a simple and inexpensive means of experimenting with raster scan graphics and mixed graphic-alphanumeric displays. No new memory need be purchased, and only two jumper connections to the main terminal board are required.

The entire circuit fits on a small board that plugs into the former character generator location. If future needs require greater resolution, then this circuit is readily unplugged or left intact with no alteration of the operation of your terminal. Meanwhile, this offers a chance to experiment with and make use of raster scan graphics of reasonable resolution without necessitating major time-consuming modifications to the terminal or purchase of a lot of components.■

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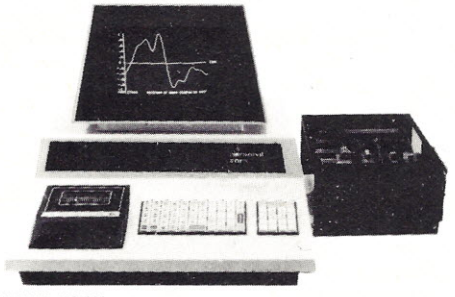
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Development of a Text-Handling Program: A Learning Experience

Working with words can be a mind-expanding experience.

Paul W. Sparks
13 Lincoln Drive
Gales Ferry CT 06335

Sometime after I had interfaced an SWTP PR-40 to my PET's user port, I decided that it would be fun to try to develop a text-handler program. I had grown tired of running a short program to type "This is a test" on my printer, and since I did not know too much about developing such a program, it seemed to be a worthwhile learning experience.

```
Z$  = "CH,[20]CD"
ZO$ = "[40]sp"
Z1$ = "STORING"
Z2$ = "WHAT PAGE DO YOU WANT?"
Z3$ = "CHOICE? BYTES LEFT"
Z4$ = "ANOTHER PAGE?"
Z5$ = "INPUT COMPLETE"
Z6$ = "LOWER CASE OR GRAPHICS"

                  GET

4000 REM*GET*
4010 GET Q$:IF Q$="" THEN 4010
4020 RETURN

        CURSOR SYMBOLS

CH       - CURSOR HOME
CS       - CLEAR SCREEN
CL       - CURSOR LEFT
CR       - CURSOR RIGHT
CU       - CURSOR UP
CD       - CURSOR DOWN
SP       - SPACE
REV      - REVERSE PRINTING ON
REV-OFF  - REVERSE PRINTING OFF
```

Table 1.

I should point out that the program presented here does not purport to be a highly polished $50 program, although it is quite workable. The purpose is to present ideas and problems with their possible solutions and to develop an interest in the reader to perhaps improve upon it for his own uses.

The first step is to establish the initial goals of the project, that is, what do you want to accomplish? In this case, my initial goals were to write to the screen, store the text in memory, print the text to the screen from the memory and print the text on the printer from the memory.

Writing

The first goal seemed direct. Using the GET and PRINT instructions, you just clear the screen and type away. After working for a short time without a cursor (there is none with GET), I realized that guessing where the next PRINT position would be was for the birds. However, I easily solved this with a simple GOSUB routine (see Example 1). And it worked fine . . . until I noticed a spelling error.

```
      PRINT Q$
      GOSUB 1000
1000  PRINT "REV/SP/REV-OFF";
      FOR I = 1TO200:NEXT I
      PRINT"CL/SP/CL";
      FORI = 1TO200:NEXT I
      RETURN
```

Example 1.

When I moved the cursor up the screen to fix it, everything in the cursor's path was erased! I then spent several hours trying to figure out how to PEEK ahead, store the then incumbent character, walk over it and replace the character in its original position. Considering that one could be going in any of four directions, this became a time-consuming algorithm (execution time) and an impractical solution to my problem.

So it was time to hit the books again. I came across a short article by Harry J. Saal in *The Paper*, wherein he described a method to turn on the cursor by POKEing 584,0. Sure enough, this did the trick, and I could go walking all over my text without wiping it off the screen. However, there were some new problems associated with this fix, which we will consider later.

This program is set up as a series of subroutines that the reader can pick and choose to use in his or her application. I have 24K of memory and use all sections, plus 20 pages of storage. A nice version can be put in 8K, but it's up to you to determine what parts to use and expand. Some parts of what I have are not of use to me at this time. For example, my printer does not have lowercase, but I use lowercase in the program, for, in the future, I hope to have a better printer.

Table 1 lists the string variables that are used as instructions throughout the program and the cursor symbols used in the program listings. It also lists

```
6000 REM*WRITE*
6006 GOSUB 6300
6010 PRINT "CS";
6020 Q$=""
6025 POKE 548,0
6030 GOSUB 4000
6034 IF S1=1 THEN GOSUB 4600
6035 IF Q$="\" THEN PRINT CHR$(13);:
     PRINT "\": GOTO 6095
6040 PRINT Q$
6090 GOTO 6025
6095 POKE 548,1
6100 GOTO 6500
```

Table 2.

GOSUB 4000, which is the basic utility subroutine used to GET a character from the keyboard. You should also be aware of the DIM instructions that are contained in Table 16, lines 120 to 124. Failure to insert the appropriate DIM statement for the appropriate usage will produce a DIM ARRAY ERROR at the most inconvenient times. Therefore, you may want to start by inserting the appropriate DIM instructions in your program.

The section (subroutine) on writing on the screen is briefly explained as follows (see Table 2). Line 6006 GOSUBs to a routine to ask if lowercase is desired (Table 3); if so, it sets the flag, S1 = 1. Then the screen is cleared, and the string variable is set to null. The cursor is turned on (line 6025), and GOSUB 4000 gets Q$ as long as Q$ is not null. Line 6034 identifies that lowercase is desired, sending the program to the subroutine 4600 (Table 4). Line 6035 recognizes that the end of the page has been reached and terminates the write sequence. Line 6040 prints Q$ on the screen, while line 6090 sends you back to do it again. Line 6095 minimizes blanking from the cursor.

Storing Text

My second goal, to store the text in the memory for subsequent retrieval, also presented a few challenges. However, except for sorting out the translation from PET's memory code to ASCII code, all steps are direct. The basic approach is to PEEK each position on the screen, convert the character to ASCII code and store that value in 40-character strings. Table 5 lists the basic program.

The first mistake I committed was to make every character a string. This might be appropriate for an EDIT capability, but one page of 20 lines (720 characters) took up seven bytes to identify and point to each character plus the actual byte that described the character. That came out to a cool 5760 bytes to store one page! The lack of space became painfully obvious when I tried to run the first program with DIM statements for ten such pages. There weren't 57,600 bytes in my memory!

The next step was to make each line into a string (lines 6530 through 6560), which came out to only 860 bytes per page. This put the program in the ball park. A useful version of this program in 8K memory can handle five pages nicely.

Briefly, line 6505 sets the initial conditions; line 6510 selects the desired page (GOSUB 4900); line 6512 returns to the main program if you decide not to store the page (enter an "*" for the page number); and line 6515 tells you what page you are storing. Lines 6520 and 6525 set up the page; line 6527 stops the store if there are more than 20 lines; and lines 6530 through 6550 PEEK the screen and convert PET code to ASCII code. Line 6560 constructs the string, and line 6570 terminates the page if a "\" is entered. Line 6595 prints an "*" to keep you from being bored while the storing process is going on. Line 6600 GOSUBs to store the strings (GOSUB 4700), and lines 6675 through 6680 represent overkill to keep my act clean. Line 6690 repeats the whole process over again. Tables 6 and 7 list the two subroutines.

The heart of this section lies in the translation algorithms, lines 6538 through 6548, to convert the PET code to ASCII code. The first line removes any reverse character because the cursor that was manufactured back in the write section occasionally leaves the reverse character, and no amount of trying to reset the cursor corrects the problem. Therefore, I decided to leave the reversed characters on the screen while writing, as long as they were deleted when stored. Lines 6540, 6542, 6544 and 6546 handle the actual conversion nicely. This is summarized in Table 8. Line 6548 is a defensive code to correct a periodic problem of @ being printed for a space.

Before I proceed to the next section, a few comments on the subroutines are in order. Subroutine 6300 in Table 3 is straightforward, but it should be noted that POKEing the standard graphic in line 6325 before making the selection is efficient and tidy. The subroutine to operate like a typewriter is taken right from *TIS Workbook #4* (Table 4).

The subroutine to select the correct page is more subtle

```
6300 REM*LOWER CASE?*
6305 S1=0
6308 PRINT Z$+Z0$+Z0$
6310 PRINT "CS";:PRINT Z$+Z6$
6320 GOSUB 4000
6325 POKE 59468,12
6330 IF Q$="L" THEN POKE 59468,14:
     S1=1
6340 RETURN
```

Table 3.

```
4600 REM*LOWERCASE/SHIFT*
4610 B1%=0:S2=ASC(Q$)
4620 IF S2>64 AND S2<91 THEN B1%=128
4630 IF S2>192 AND S2<219 THEN B1%=-128
4640 Q$=CHR$(S2+B1%)
4699 RETURN

THIS SUBROUTINE IS TAKEN FROM TIS
WORKBOOK #4
```

Table 4.

```
6500 REM*STORE*
6505 X=32727:D0$="":J=0
6510 GOSUB 4900
6512 IF T0$="*" THEN RETURN
6515 PRINT Z$+Z1$
6520 X=X+40
6525 J=J+1
6527 IF J>20 THEN T1=1:GOTO 6680
6530 FOR I=1TO40
6535 A2=PEEK(X+I)
6538 IF A2>127 THEN A2=A2-128
6540 IF A2<32 THEN D2=A2+64:GOTO 6548
6542 IF A2=>32 AND A2<64 THEN D2=A2:
     GOTO 6548
6544 IF A2=>64 THEN D2=A2+128:GOTO 6548
6548 IF D2=96 OR D2=224 THEN D2=32
6550 D2$=CHR$(D2)
6560 D0$=D0$+D2$
6570 IF D2$="\" THEN T1=1
6590 NEXT I
6595 PRINT "*"
6600 GOSUB 4700
6675 D0$=""
6680 IF T1=1 THEN T1=0:J=0:I=0:T0=0:PRINT
     Z$+Z0$+Z0$+Z0$:RETURN
6690 GOTO 6520
```

Table 5.

```
4900 REM*WHAT PAGE*
4905 PRINT Z$+Z0$+Z0$+Z0$
4910 PRINT Z$+Z2$;
4915 PRINT T9$
4920 GOSUB 4000
4922 T0$=Q$:Q$=""
4925 IF T0$="*" THEN RETURN
4928 IF T0$>"9" THEN T0=10:GOTO 4935
4930 T0=VAL(T0$)
4935 PRINT T0$:FOR I=1TO300:NEXT I
4940 PRINT Z$+Z0$
4947 IF LEN(T9$) 16 THEN T9$=RIGHT$
     (T9$,16)+T0$:GOTO 4999
4950 T9$=T9$+T0$
4999 RETURN
```

Table 6.

```
4700 REM*PX$=D0$*
4701 IF T0>9 THEN GOTO 4400
4703 IF T0>4 THEN GOTO 4755
4705 IF T0=0 THEN P0$(J)=D0$:RETURN
4715 IF T0=1 THEN P1$(J)=D0$:RETURN
4725 IF T0=2 THEN P2$(J)=D0$:RETURN
4735 IF T0=3 THEN P3$(J)=D0$:RETURN
4745 IF T0=4 THEN P4$(J)=D0$:RETURN
4755 IF T0=5 THEN P5$(J)=D0$:RETURN
4760 IF T0=6 THEN P6$(J)=D0$:RETURN
4765 IF T0=7 THEN P7$(J)=D0$:RETURN
4770 IF T0=8 THEN P8$(J)=D0$:RETURN
4775 IF T0=9 THEN P9$(J)=D0$:RETURN
4799 RETURN
```

Table 7.

```
4800 REM*D0$=PX$*
4801 IF T0>9 THEN 4500
4803 IF T0>4 THEN 4850
4805 IF T0=0 THEN D0$=P0$(J):RETURN
4810 IF T0=1 THEN D0$=P1$(J):RETURN
4820 IF T0=2 THEN D0$=P2$(J):RETURN
4830 IF T0=3 THEN D0$=P3$(J):RETURN
4840 IF T0=4 THEN D0$=P4$(J):RETURN
4850 IF T0=5 THEN D0$=P5$(J):RETURN
4860 IF T0=6 THEN D0$=P6$(J):RETURN
4865 IF T0=7 THEN D0$=P7$(J):RETURN
4870 IF T0=8 THEN D0$=P8$(J):RETURN
4875 IF T0=9 THEN D0$=P9$(J):RETURN
4899 RETURN
```

Table 10.

(Table 6). After the desired page is selected by the GET instruction, the Q$ value is transferred to T0$ and Q$ is set to null. This was required because Q$ would remain in the system, and when the store subroutine was complete and returned to the main program, the first instruction asked what you wanted to do next.

If the stored character answered that question logically, then the program would go off in that direction without interruption. For example, if page C was selected for screen as soon as it was printed on the screen, the screen would clear and the cryptic question, "What cassette is desired?" would appear. It took quite a bit of time to figure that one out.

Line 4928 utilizes PET's consideration of a letter character as having a larger value than 9; the statement A>9 is logically true. Using pages A-J (versus 10-19) allows the use of GET instead of INPUT, making it much easier for the user (one character and no RETURN). Lines 4947 and 4950 let the user know the last several pages selected. This is convenient because in past versions I had to write down pages that I had used or I surely would have copied over a page that I had saved.

The subroutine, 4700, that actually stores the strings is shown for pages 0-9. I also used pages A-J, and line 4701 directs the program to the appropriate subroutine for those pages. That subroutine is identical to 4700, except T0$ = A through J, and the pages are PA$(I) through PJ$(I). Line 4703 shortens the time to search the file. If fewer pages are used in a program, then the appropriate pages and subroutines should be selected.

THIS TABLE SHOWS THE EQUIVALENT VALUES BETWEEN THE PET CODE AND ASCII CODE.

PET CODE	ASCII
0 - 31	64 - 95
32 - 63	32 - 63
64 - 95	192 - 223
96 - 127	224 - 255

Table 8.

Retrieve Text

The third objective was to write from the memory to the screen. The listing in Table 9 does this. Line 7010 GOSUBs to select the page (see Table 6), and line 7025 sets up to print 20 lines. Line 7030 GOSUBs to select the line (string) to be printed (see Table 10). If that line is "\" then line 7040 will terminate the print. Line 7050 prints the string, and line 7090 repeats the process. Note that there are two methods to escape this subroutine: print more than 20 lines or find the end of the page delimiter, "\".

```
7000 REM*SCREEN*
7010 GOSUB 4900
7020 PRINT"CS";
7025 J=J+1: IF J>20 THEN J=0:RETURN
7030 GOSUB 4800
7040 IF Q$="\" THEN J=0;RETURN
7050 PRINT D0$;
7090 GOTO 7025
```

Table 9.

```
8000 REM*PRINTER*
8010 POKE 59459,255
8020 GOSUB 4900
8030 PRINT"CS";"PRINTING"
8035 J=J+1: IF J>20 THEN J=0:GOTO 8150
8040 GOSUB 4800
8045 PRINT D0$;
8050 FOR I=1TO40
8055 D1$=MID$(D0$,I,1)
8060 D1=ASC(D1$)
8062 IFD1$="\" THEN J=20: I=40:D1=13
8065 POKE 59457,D1
8080 POKE 59468,PEEK(59468)AND31OR192
8085 POKE 59468,PEEK(59468)OR224
8090 NEXT I
8095 GOSUB 8200
8100 GOTO 8035
8150 POKE 59459,0:POKE 59468,0:POKE 59457,0
8160 D1=0:D1$="":J=0
8190 RETURN
8200 REM*TIMING*
8210 T=TI
8220 IF TI T+60 THEN RETURN
8230 GOTO 8220
```

Table 11.

Printing Text

My fourth goal was to print the text on a printer. My printer is a simple line printer connected directly to PET's 8-bit parallel user port. Therefore, the use of the port must be programmed. To accomplish this, the data direction must be set up for output (all lines) by POKEing 59459,255. Then the character to be printed is placed on the data register (POKE 59457,D1) and the printer is told that the data is ready (POKE 59468,PEEK(59468) AND 31 OR 192) and then reset (POKE 59468,PEEK(59468) OR 224).

Usually after the data is accepted, the printer will send a signal back. However, it is not necessary with the SWTP PR-40 printer (a one microsecond wait is all that is required). When 40 characters are stored in the printer buffer or a RETURN is sent, a one-second delay in the program is required while the printer prints. The listing to print is presented in Table 11.

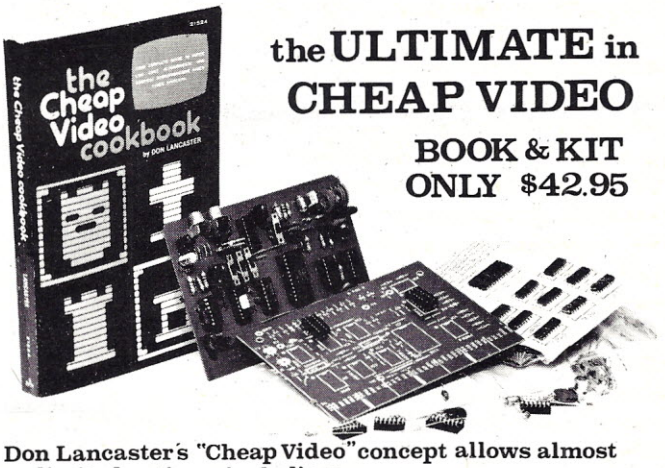
Therefore, to point out the highlights, line 8010 sets up the user port for output. Line 8020 GOSUBs to get the line (string) from the memory. Line 8045 prints the string on the screen, while lines 8050 through 8060 break the string up into one-character bytes that the printer can handle. Line 8062 prepares to jump out of the subroutine if the page delimiter is found.

Lines 8065 through 8085 send the character to the printer. Line 8090 repeats the process until all characters of the string are printed. Line 8100 gets the next string to be printed. Line 8150 sets the user port back to normal when it is

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no longer needed. This is more than just good housekeeping because if it were not reset properly the cassettes would not work. Of course, I found out the hard way.

The rest of the subroutine sets up the timing loop while the printer is actually printing a line. The only subtle area of this section of the program is resetting all of the parameters.

Normally when you establish a set of goals for a complex project, you add to these goals as new ideas develop. This program development was no exception. Two other areas of interest developed as being highly desirable (to me, anyhow): developing the use of cassettes (#1 and #2) to store and retrieve text, and a limited edit capability.

Cassette Handling

The program section that was developed to store text on cassettes was more complex than I had originally expected. The program is in three sections: the selection/execution part (Table 12), the write section (Table 13) and the read section (Table 14).

In the selection section, the first order of business is to select the cassette that is to be used; my system uses an external cassette. The open statement can use variables for each instruction, and line 9110, "open T4, T2, T3 – 1, N$," requires that each variable be selected. Lines 9020 through 9035 select T2, the cassette desired. Lines 9040 through 9065 establish T3, whether to read or write. Lines 9070 through 9077 get the file name. If no file name is desired (write) or you cannot remember what the file name is (read), then just enter a null (double quotes, ""). Lines 9080 through 9089 get T4, the file number. Lines 9100 and 9105 set up the cassette registers to ensure proper operation due to a ROM glitch in PET.

It should be noted that the people-interactive statements, such as line 9065, are not only nice to have, but keep the program going when the operator makes a mistake. This can happen to the best users.

The write routine (Table 13) must overcome one major deficiency of the PET cassette-handling system: commas and some other program control characters are ignored by the system and not stored on tape. This can be disconcerting when you try to store text and all of the punctuation is missing.

Fortunately, the solution is simple: put the string to be stored in quotes. You should remember that the basic system in this program handles each 40-character line as a string. Therefore, a 42-character string is constructed by adding the quote character to each end of the string. This is done in line 9340 (CHR$(34) = quotation mark, and D0$ is the original line string).

Since the delimiter ("\") is no longer the first character in the last line, then it is necessary to skip the first character and look at the second element in a line to determine if the page is ended. This is accomplished in line 9350 by using the MID$ instruction. In the same manner, the MID$ instruction is used in line 9345 to print on the screen the line that was just stored on tape.

However, PET did finally win out. I could find no way to store a quote. Therefore, when using this program to store text on tape, you cannot use a quotation mark within the text. Also, you cannot use the delimiter in any section of the program, because it will stop any function that is in progress.

However, if you keep these two simple restrictions in mind, the program will store quite well. Line 9320 puts the file name on tape (so it can be read out and saved). GOSUB 9800 advances the tape periodically, which helps to ensure reliable operation in the read mode. Line 9325 prints the file name at the bottom of the screen and sets up the screen to keep track of the write evolution, while line 9335 asks what page is desired.

Lines 9340 through 9355 set up the strings, put them on tape and check to see if the end of the page has been reached. Line 9360 steps the line number and checks if there are more than 20 lines printed. If not, then line 9370 will start the whole process over again. Lines 9380 through 9390 ask if another page is to be put on tape; if so, the program jumps to the line that sets up a new page. Lines 9400 through 9430 set a section delimiter ("⧄") and close the file. This delimiter is not totally necessary because the close instruction also sets a status word, but it has been found prudent, while reading, to put in a little insurance.

Table 14 lists the read subroutine. Now that the write routine is understood, the requirements of the read section are simple. Lines 9520 through 9535 get the file name, print it at the bottom of the screen and set up the screen to receive the page. Line 9540 reads the string (line) and prints it on the screen. Note that the middle 40 characters are printed to eliminate the quotes that were attached to both ends.

```
9000 REM*CASSETTE*
9010 PRINT"CS";:PRINT"WHICH CASSETTE
     DO YOU CHOOSE?"
9020 GOSUB 4000
9030 T2=VAL(Q$):PRINT T2:PRINT
9035 IF T2>2 OR T2<1 THEN PRINT
     "PLEASE 1 OR 2":GOTO 9020
9040 PRINT "DO YOU CARE TO READ OR
     WRITE?"
9050 GOSUB 4000
9055 PRINT Q$
9060 IF Q$="R" THEN T3=1:GOTO 9070
9062 IF Q$="W" THEN T3=2:GOTO 9070
9065 PRINT "PLEASE EITHER 'R' OR
     'W'":GOTO 9050
9070 PRINT:PRINT"WHAT IS THE
     FILENAME?"
9075 INPUT Q$
9077 N$=Q$
9080 PRINT:PRINT"WHICH FILE?"
9085 GOSUB 4000
9087 T4=VAL(Q$):PRINT T4
9089 IF T4>2 OR T4<1 THEN PRINT
     "PLEASE 1 OR 2":GOTO 9085
9100 IF T2=2 THEN POKE243,58:
     POKE244,3
9105 IF T2=1 THEN POKE243,122:
     POKE 244,2
9110 OPEN T4, T2, T3-1, N$
9130 IF T3=1 THEN GOSUB 9500
9140 IF T3=2 THEN GOSUB 9300
9190 RETURN
```

Table 12.

```
9300 REM*SUB WRITE*
9310 J=1
9320 PRINT#T4,N$:GOSUB 9800
9325 GOSUB 4900:PRINT"CS";:PRINT
     Z$+N$:PRINT"CH"
9335 GOSUB 4800
9340 D0$=CHR$(34)+D0$+CHR$(34)
9345 PRINT#T4,D0$:PRINT MID$(D0$,2,40);
9350 IF MID$(D0$,2,1)="\" THEN J=20
9355 GOSUB 9800
9360 J=J+1:IF J>20 THEN 9380
9370 GOTO 9335
9380 PRINT Z$+Z4$
9385 GOSUB 4000
9390 IF Q$="Y" THENJ=1:GOTO 9325
9400 PRINT Z$+Z0$+Z0$
9410 PRINT#T4,"⧄"
9420 CLOSE T4:T2=T3=T4=0
9430 RETURN
9800 REM*SUB TIME*
9810 IF T2=2 THEN 9850
9820 T0=TI:POKE59411,53
9830 IF TI-T0<6 THEN 9830
9840 POKE59411,61:RETURN
9850 T0=TI:POKE59456,207
9860 IF TI-T0<6 THEN 9860
9870 POKE59456,223:RETURN
```

Table 13.

```
9500 REM*SUB READ*
9510 J=0:Q1=0
9520 INPUT#T4,Q$:N$=Q$
9530 PRINT"CS"
9533 PRINT Z$+N$:PRINT"CH"
9535 J=1
9540 INPUT#T4,D0$:PRINT MID$(D0$,1,40);
9550 IF MID$(D0$,1,1)="■" THEN J=20:Q1=
9555 IF ST=64 THEN J=20:Q1=1
9560 IF MID$(D0$,1,1)="↖" THEN J=20
9570 J=J+1
9580 IF J<21 THEN 9540
9585 J=0:GOSUB 6500
9587 IF Q1=1 THEN 9600
9590 GOTO 9530
9600 CLOSE T4
9610 T2=T3=T4=Q1=0
9620 PRINT Z$+Z0$+Z0$
9630 PRINT Z$+Z5$:FOR I=1TO500:NEXT I
9650 PRINT Z$+Z0$+Z0$
9690 RETURN
```

Table 14.

Lines 9550 through 9560 test for the end of the page and the end of the file. Line 9570 steps the line, and line 9580 reads the next line if the page is not complete. If the page is complete, then line 9585 GOSUBs to the store section. Upon return from the subroutine, line 9590 returns to read the next page if the end of the file has not been reached. Line 9587 sends the program to line 9600 if the end of the file has been reached (Q1 = 1). Lines 9600 through 9690 close the file and tell the operator that the file is complete.

That is all there is to it, and even if you are not trying to write a text editor system, this should contain some useful hints for cassette filing of strings.

Edit

The edit section is the most rudimentary of all the sections. To properly edit is a complex function, which is not appropriate to this discussion, besides, I have not worked very much of it out yet. Therefore, all that is allowed is to correct spelling errors and other small mistakes. However, even that has been a useful and worthwhile function. I am using the program as presented here to do this article, and, believe me, I make many typing and grammatical errors.

In any event, Table 15 lists the edit section as it presently stands. First, the section to print a page on the screen is used (line 5050), and then the lowercase subroutine is used (line 5100). After these two subroutines have been used, the cursor is placed at the bottom of the text in line 5110 and the print section is entered to turn on the cursor and write on the screen. After the corrections have been completed, the user places the page delimiter at the bottom of the text and the program returns to line 5400, which GOSUBs to store the page.

```
5000 REM*EDIT*
5050 GOSUB 7000
5100 GOSUB 6300
5110 PRINT "CS"+Z$+"CU/CU";
5150 GOSUB 6020
5400 GOSUB 6500
5599 RETURN
```

Table 15.

Executive Program

Now that we have all these useful subroutines, how do we keep them separate and coordinated? That is the purpose of the executive program, the storehouse of program variables and the traffic director. It may seem strange to address the first part of the program last, but, in fact, that is just the way it should be done.

When you are constructing a program, you should lay out each part in sections. The first 100 lines, for example, could contain only program identification information. Then perhaps the second 100 lines could be used for DIM statements and string definitions. Then the next 100 lines could be used for instructions. The rest of the first 1000 lines could then be used for the actual direction instructions. The listing in Table 16 is the executive section of this program.

Lines 111 through 119 list all of the comments that are used in more than one section of the program (also listed in Table 1). Line 111 (Z$) and line 112 (Z0$) are used, respectively, to position and erase the comments. Lines 120 through 124 are the DIM statements to set aside room for the pages. Lines 200 through 275 list the instructions and are repeated if requested during the operation of the program. Line 300 tells the number of free bytes, which is convenient to have from time to time.

Lines 302 to 320 inquire what you desire to do next: writing/storing, print on screen, print on printer, use the cassette, edit, finish, review the options or choose either lowercase type or graphics. This latter function is useful, especially the first time you find yourself in the wrong mode. The finish selection is just a tidy way of terminating a program. Line

```
100 REM*P.W. SPARKS-TEXT EDIT*
110 X=32727
111 Z$="CS/[20]CD"
112 Z0$="[40]sp"
113 Z1$="STORING"
114 Z2$="WHAT PAGE DO YOU WANT?"
115 Z3$="CHOICE? BYTES LEFT"
116 Z6$="LOWER CASE OR GRAPHICS?"
117 Z4$="ANOTHER PAGE?"
119 Z5$="INPUT COMPLETE"
120 DIM P0$(20),P1$(20),P2$(20),P3$(20)
121 DIM P4$(20),P5$(20)
122 DIM P6$(20),P7$(20),P8$(20),P9$(20)
123 DIM PA$(20),PB$(20),PC$(20),PD$(20)
    ,PE$(20),PF$(20),PG$(20),PH$(20)
124 DIM PI$(20),PJ$(20)
200 PRINT"CS"
205 PRINT"INSTRUCTIONS?"
210 GOSUB 4000
215 IF LEFT$(Q$,1)="N" THEN 300
220 PRINT"CS"
225 POKE 59468,14
230 PRINT:PRINT"THIS IS A GENERAL
       PURPOSE TEXT FILE AND"
232 PRINT"PRINT PROGRAM.  YOUR CHOICES
       ARE:"
233 PRINT
234 PRINT"(1)W - WRITE AND STORE"
236 PRINT"(2)S - PUT PAGE ON THE
    SCREEN"
238 PRINT"(3)P - PRINT PAGE ON THE
    PRINTER"
240 PRINT"(4)C - SAVE A PAGE ON
    CASSETTE"
242 PRINT"(5)E - EDIT A PAGE"
244 PRINT"(6)F - FINISH"
246 PRINT"(7)? - REVIEW THE OPTIONS"
250 PRINT:PRINT
260 PRINT"TO MAKE A CHOICE ENTER
       THE APPROPRIATE"
262 PRINT"LETTER AND FOLLOW
       INSTRUCTIONS.  IF YOU"
264 PRINT"NEED TO REVIEW THE
       OPTIONS JUST ENTER"
266 PRINT"'?' WHEN ASKED FOR A CHOICE"
270 PRINT:PRINT"ANY KEY":PRINT
275 GOSUB 4000
300 T6=FRE(0):Q$=""
302 PRINT Z$+Z0$+Z0$+Z0$
305 PRINT Z$+Z3$;T6
310 GOSUB 4000
320 PRINT Q$: FOR I=1TO500:NEXT I
330 IF Q$="W" THEN GOSUB 6000
331 IF Q$="S" THEN GOSUB 7000
332 IF Q$="P" THEN GOSUB 8000
334 IF Q$="C" THEN GOSUB 9000
335 IF Q$="E" THEN GOSUB 5000
336 IF Q$="F" THEN 350
338 IF Q$="?" THEN 220
339 IF Q$="G" THEN POKE 59468,12
340 IF Q$="L" THEN POKE 59468,14
349 GOTO 300
350 PRINT"CS";"THAT'S ALL FOLKS!"
355 POKE 59468,12
399 END
```

Table 16.

399 is not normally required with PET, but when using the subroutine approach, you need it to keep from falling through into one of the subroutines.

Conclusions

As I stated earlier, I wrote this entire article (and one shorter one) on this routine, so it is technically debugged, if not completely polished. For example, I have an entire 60 minute cassette filed with text without a glitch. On the other hand, if you do not have a full-size keyboard, it is easy to hit the wrong key and sometimes crash your routine. If you do not change the program listing or go to RUN, everything will stay just the way it is. Therefore, if you type in "GOTO 300," it will place you in the choice mode, and you will have all text stored at that point. Actually, to LIST the program, I would LIST the section desired and GOTO 6500.

Knowing your entry points is useful, particularly if the program concerns large blocks of data. To polish the program, you should program out items that could crash the program. For example, the STOP key should be disabled.

If you put all these sections together, a slow, but useful text-handling program will result. More important is that all of these areas can be improved and tailored to an individual's needs to develop sophisticated programs for a low cost, that is, your time. I intend to concentrate on the following improvements:

- machine-program the screen PEEK section to increase its speed
- machine-program the printer output to increase its speed
- improve the edit function
- interface the program to a floppy-disk unit to store the pages

Table 17 lists all the variables that were used and should help in any development that the reader should care to make.

My floppy disk just arrived in the mail yesterday, so I'm off to work on that improvement. Also, I recently received an IBM-style keyboard, which has improved my typing speed and error rate considerably. How about you? Can you take this start and improve it to your own needs? Maybe you can use your own version and write the next installment for *Microcomputing*. My hope is that many of us can take a subject and carry on a running development for the education and entertainment of everyone.■

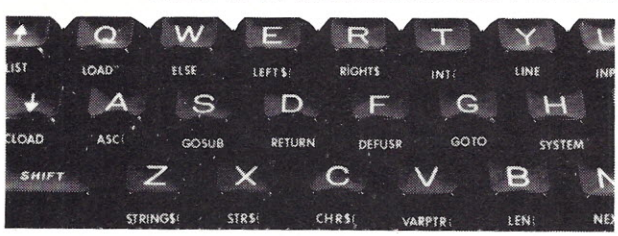
Z$ through Z6$ (see Table 1)
D0$—line to be stored
D1$—each character to be printed
D2$—character in line to be stored (D2$ = CHR$(D2))
N$—file name
P0$(I) through P9$(I)—first ten pages
PA$(I) through PJ$(I)—second ten pages
Q$—dummy variable
T0$—page number
T9$—string to list pages selected
A2—PEEKed value
B1%—lowercase variable (B1% = ±128)
D1—ASCII value of each character to be printed
D2—PEEKed value converted to ASCII code
I—dummy variable
J—dummy variable
Q1—end of file flag
S1—lowercase flag (S1 = 1 if use lowercase)
S2—lowercase variable (S2 = ASC(Q$))
T—time
T0—page number (1-10; A-J pages are all 10)
T1—flag end of page
T2—cassette number
T3—cassette read or write (1 = read; 2 = write)
T4—file number
T6—number of free bytes
X—initial screen memory position

Table 17. Variables and constants.

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✓ Reader Service index—page 241

A Quick Screen-Clear for the Challenger II

Prevent development of a microcomputer inferiority complex.

Richard Lary
PO Box 234
Kilauea HI 96754

I don't know about you, but I don't like to see my OSI Challenger II outdone by other computer systems. For example, several systems have available a BASIC command that clears the video display in the blink of an eye. OSI owners, who are not so fortunate, must clear the display using a loop containing a PRINT statement. This method works but is rather slow. There is a faster and better method.

Surely you have noticed how quickly the screen is cleared when you press the BREAK key. The code that accomplishes this clearing of the screen is programmed in the system's monitor ROM; unfortunately, the program in ROM is not written as a subroutine and cannot be called by a BASIC program. I have borrowed this code from the monitor and added a return-from-subroutine instruction to the end of the code. By placing this code and the added RTS instruction in RAM, you have a clear-screen subroutine that can be called by a BASIC program.

Program Location

Program 1 shows the assembly listing of this subroutine. Since the program uses relative branching and zero-page addressing, the program can be located anywhere, unchanged in RAM. As shown, Program 1 is for Challenger II systems with the 540 video board. Changing the value of the last-page index from D8 to D4 will allow Challenger I owners to use the program.

Since the clear-screen subroutine will be located in memory along with the BASIC program that calls the subroutine, the memory size allowed for BASIC must be set lower than the starting address of the subroutine. This prevents BASIC from overwriting the subroutine. Although you can place the subroutine anywhere in memory, the best location is in the last 25 bytes of available memory. This way, the remaining lower bytes will be available to BASIC.

```
                        SCNADR = $FE
                        LASTPG = $D8
                        SPACE  = $20

OFE6  A2 D8   BEGIN     LDX #LASTPG     LOAD X REG W/ LAST PAGE HI BYTE
OFE8  A9 DO             LDA #$DO        LOAD ACCUM W/ SCREEN ADDR HI BYTE
OFEA  85 FF             STA SCNADR+1    SAVE ACCUM
OFEC  A9 OO             LDA #$OO        LOAD ACCUM W/ SCREEN ADDR LO BYTE
OFEE  85 FE             STA SCNADR      SAVE ACCUM
OFFO  A8                TAY             LOAD Y REG W/$OO
OFF1  A9 20             LDA #SPACE      LOAD ACCUM W/ ASCII SPACE
OFF3  91 FE   LOOP      STA (SCNADR),Y SAVE AT SCREEN ADDR LO BYTE + Y REG
OFF5  C8                INY
OFF6  DO FB             BNE LOOP        DONE W/ PAGE? NO,DO NEXT LOCATION
OFF8  E6 FF             INC SCNADR+1    YES,SCREEN ADDR HI BYTE = HI BYTE+1
OFFA  E4 FF             CPX SCNADR+1    SCREEN ADDR HI BYTE = LAST PAGE?
OFFC  DO F5             BNE LOOP        NO, DO NEXT PAGE
OFFE  60                RTS             YES,DONE! RETURN TO BASIC
```

Program 1. Clear-screen subroutine

Memory Size

Once you have decided on the starting address, you can use either of the following methods to set the memory size. One method is to cold-start the system. Before loading the BASIC program, enter the starting address −1 (in decimal) in response to the monitor's prompt: MEMORY SIZE? This method has a disadvantage in that it requires you to remember to set the memory size before you load the program.

A better method is to let your BASIC program set the memory size for you. There are two zero-page memory locations that store the address of the last memory location available to BASIC; the low- and high-order bytes of the last address are stored in decimal locations 133 and 134, respectively. You can use BASIC to POKE the starting address −1 into these two memory locations.

For example, in a 4K system the last address in RAM would be 4095 decimal; the starting address for the subroutine would be 4070 decimal. The memory size for BASIC would be the starting address −1, or 4069 decimal. You then need to convert this decimal value into its hex value, which in this case is =0F E5.

In order to use POKE statements, you have to convert the high- and low-order bytes of this hex value into their respective decimal values. High-order byte = 0F = 15 decimal and low-order byte = E5 = 229 decimal. Now that you have the decimal values for the high and low-order bytes of the last address available to BASIC, you can use the following POKE statements to set the memory size to 4069: POKE 133,229 and POKE 134,15.

Placing these POKE statements at the beginning of a BASIC program allows the program to set the memory size. Should you ever need to set the memory size after loading a program, you can use these two POKE statements to set the memory size without having to cold-start the system.

The Program

The BASIC program listed in Program 2 contains the code required to set the memory size, load the subroutine and call the subroutine. Line 30 sets the memory size as described and includes the RUN command, which directs program execution to begin with the line number following the line containing the RUN command. If you leave out the line number, the program will get tied up in an endless loop. Also, be sure that any variable assignments are made in lines after the line containing the RUN command; otherwise, the RUN command will set all previously assigned variables to zero. The DATA statements in lines 60-80 contain the decimal values for the machine-language instructions from the assembly listing shown in Program 1. Challenger I owners will have to change 216 in line 60 to 212 in order to run the program. The variable SA in line 100 must be set equal to the subroutine's starting address in decimal. Line 120 READs the machine-

language instructions from the DATA statements and POKEs the instructions into memory.

With the exception of the REM statements, the statements in lines 10–120 would normally be placed at the beginning of the BASIC program, which will be calling the clear-screen subroutine.

To call a machine-language subroutine from BASIC, BASIC requires that the starting address of the subroutine be stored in the USR vector. The USR vector is simply two zero-page memory locations, 11 and 12 decimal, which tell BASIC where the machine-language subroutine starts.

Line 160 sets up the USR vector by POKEing memory locations 11 and 12 decimal with the decimal values of the low-order and high-order bytes of the subroutine-starting address. Line 170 causes BASIC to execute the machine-language subroutine pointed to by the USR vector.

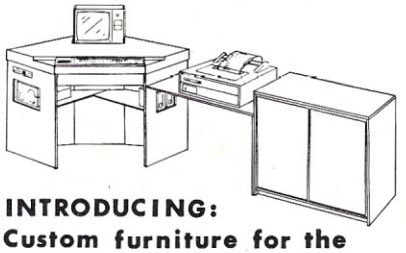
If the clear-screen subroutine is the only machine-language subroutine that your BASIC program will be calling, then you can set up the USR vector once at the beginning of the program and use the statement in line 170 anywhere in your program to call and execute the clear-screen subroutine. If your program will be calling more than one machine-language subroutine, you will have to reset the USR vector each time BASIC calls a machine-language subroutine, in order to call the right subroutine.

So, OSI owners, by using the statements from Program 2 in your BASIC programs, you, too, can now clear your screen in the blink of an eye. ■

```
 10  REM--MACHINE LANGUAGE CLEAR SCREEN SUBROUTINE
 20  REM--SET MEMORY SIZE TO 4069
 30  POKE 133,229 : POKE 134,15:RUN 40
 40  REM--DATA STATEMENTS CONTAIN MACHINE LANGUAGE
 50  REM--SUBROUTINE INSTRUCTIONS IN DECIMAL
 60  DATA 162,216,169,208,133,255,169,0,133,254
 70  DATA 168,169,32,145,254,200,208,251,230,255
 80  DATA 228,255,208,245,96
 90  REM--SET VARIABLE 'SA' EQUAL TO SUBROUTINE STARTING ADDRESS
100  SA = 4070 : REM--4070 = OFE6 HEX
110  REM--READ INSTRUCTIONS AND POKE INTO MEMORY
120  FOR LC = SA TO SA + 24 : READ D : POKE LC,D : NEXT LC
130  REM--SUBROUTINE NOW LOADED AND CALLABLE FROM BASIC
140  REM--BASIC CODE TO CALL AND EXECUTE SUBROUTINE
150  REM--SET UP USR VECTOR, 11 = SA LOW BYTE; 12 = SA HIGH BYTE
160  POKE 11,230 : POKE 12,15
170  X = USR(X) : REM--CALL SUBROUTINE
180  END
```

Program 2. BASIC program.

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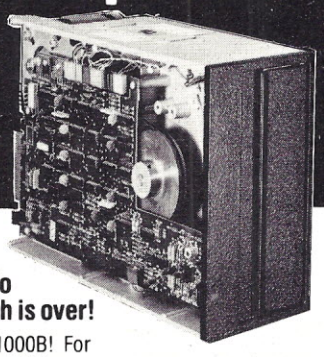
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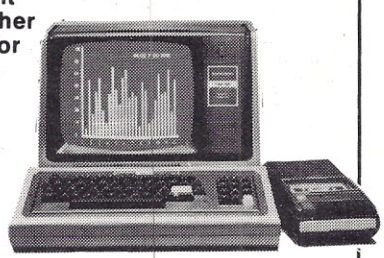
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✔ Reader Service index—page 241

The Fitful Journey to Double Density

A microcomputer engineer explores the perils and pitfalls of a new technology.

David C. Jenkins
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The purpose of this article is to review the operation of double-density floppy-disk storage and to look at some of the problems that are being encountered as the microcomputer industry changes from single-density mode of operation to double-density.

As most of us know, one of the basic problems facing the microcomputer user is the storage of information. This information may be games or inventory or accounting or other information forming part of a business data base. There are several alternatives to consider when storing information.

Data Storage Technologies

The first alternative in data storage technologies is random access memory. This technique becomes prohibitively expensive when a small business operation wants to store 4 million bytes of information that contain inventory and payroll information. A second method is the use of paper tape. However, it often is not convenient because it is bulky and is not reusable.

A third alternative is cassette tape. Cassette interfaces are relatively inexpensive, and cassette tape itself is very inexpensive. Cassette tape can store a great deal of information. Because information is stored serially on a cassette tape, cassette tape has very long and, in many instances, unacceptable access times. Typically, it takes 20 seconds or more to reach any particular file on the tape before actual reading of information can occur.

The fourth, and perhaps most attractive, alternative for many applications is disk technology.

Disks provide a large volume of data storage and fast random access to any particular item. At present there are two types of disk storage: hard disk and floppy disk. Hard disks typically store 10 megabytes or more of information on either permanent or removable platters. They may be configured to contain up to 96 megabytes or more per disk drive. This represents approximately 40,000 pages of text, which is adequate for most medium-sized business needs. However, hard-disk systems are quite expensive, often ranging in excess of $5000.

The second disk technology, floppy disk, typically costs around $1200 for a double-density floppy-disk drive with controller. A double-sided double-density floppy-disk drive and interface can store approximately one megabyte of information (approximately 400 pages of text), which is enough storage capacity for many applications. (For further information on basic requirements and hardware used in a floppy-disk drive system, readers are encouraged to consult "Floppy Disks" by Douglas Hogg in the March 1977 issue of *Kilobaud*.)

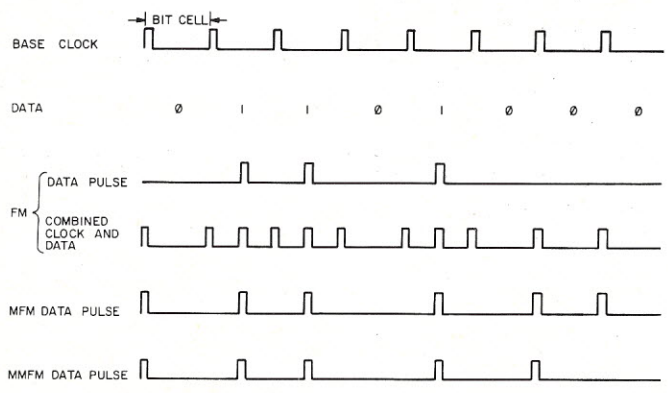


Fig. 1. Floppy-disk data encoding.

Theory of Single- and Double-Density Recording

At this point, let's briefly review the theory behind single- and double-density recording and some of the implications of this technology. Physically, double-density disk drives do not differ significantly from their single-density counterparts. Improvements in double-density record and playback heads and changes in mechanics often provide less expensive and more durable drives. These changes are minor compared to the differences in reading and writing functions.

Fig. 1 reviews encoding methods used in single- and double-density. The standard recording formats are FM (frequency modulation), MFM (modified frequency modulation, double-density) and MMFM (modified modified frequency modulation), which is a refinement of MFM. The first line of Fig. 1 indicates the basic clock frequency, which designates the bit cell in which information will be passed. The next line (Data) illustrates a sample of information. The third line shows the pulses that generate that information in a single-density FM format. Notice that information actually sent to and received from the drive is a combination of the basic clock frequency and data pulses.

The next line is MFM. Here only the data pulses will be sent to the drive; their orientation within the bit cell determines the value of that particular data pulse, be it a 1 or a 0. Every 0 is represented by a data pulse that coincides with the basic clock frequency. A 1 is represented by a pulse that occurs midway between two clock pulses. Thus, when the data pulse occurs in the middle of a bit cell, it is a 1; when it occurs in the beginning of a bit cell, it is a 0. Note: When the previous bit was a 1 and the present bit is 0, no pulse is sent to the drive.

The next line represents MMFM, a slight refinement of MFM. The data pulses once again represent 1s and 0s via their placement within the bit cell. However, the rules change slightly. If the preceding data

pulse was a 0 and the present datum is a 0, then the data pulse will not occur.

If the preceding data pulse was a 1 and the present datum is a 0, the present data pulse will not appear. If the preceding data pulse was a 1 and the present datum is a 1, a data pulse will appear. Every time there is a 1, a data pulse will appear in the middle of a bit cell. Whether or not a 0 data pulse occurs depends on the preceding datum.

Note that the density of data pulses for MFM is almost exactly one-half the density of data pulses for FM. Thus, for the same density of pulses on the diskette, MFM will record twice as much information as FM. MMFM is slightly less dense than MFM, but its complexity of encoding and decoding outweighs the slight advantage it might enjoy due to slightly less density.

The basic clock frequency for FM encoding is 250 kHz for an 8-inch diskette. When we delete the clock and leave only the data pulses in MFM, that clock rate changes to 500 kHz. The MFM data transfer rate is twice as fast as FM. The density and the speed are both doubled, which means that twice as much information can be stored in the same physical space and can be manipulated twice as fast.

Nonstandard Double-Density Operating Systems

In the computer industry, IBM is the recognized leader with a major share of data-processing system placements. Traditionally, minority companies have chosen IBM standards in order to maintain compatibility between their equipment and IBM's. Thus, in single-density floppy disk, the de facto industry standard is 128 bytes per sector as first introduced with IBM's 3740 system.

IBM's new double-density standard now specifies a minimum sector size of 256 bytes. A major problem is developing in the microcomputer industry in that some manufacturers of double-density floppy disk interfaces are modifying their hardware to provide 128 byte sectors in a double-density operation instead of moving to the de facto 256 byte format developed by IBM. As a result, we are witnessing the development of many double-density nonstandard operating systems focusing on the 128 byte sector format.

Microcomputer users familiar with cassette tape operation will find the proliferation of nonstandard operating systems familiar in that the development of similar nonstandard formats in cassette operation has resulted in at least five totally incompatible tape formats, all of which are currently in use: the Radio Shack TRS-80, the Commodore PET, Kansas City, Tarbell Bi-Phase and the Processor Technology CUTS Bi-Phase recording formats.

As we are all aware, cassette users are often faced with the difficult problem of trying to transfer information among various incompatible machines. Each device must be modified either by the addition of hardware or through sophisticated software techniques to provide compatibility. It appears that many double-density floppy users may well be faced with the same frustrating circumstances when they have to exchange information between systems.

Nonstandard File Sector Interleaving

A second major problem emerges when we consider the move from single- to double-density: data file sector interleaving. As indicated in Fig. 2, some amount of time is normally required to read a sector of information from the floppy diskette. Once that information is read, the CPU normally performs some manipulations on that information, such as a search for particular data within that sector, an alphabetizing of names that are contained within that sector or some other similar operation.

If the CPU spends much time in manipulating data read from the first sector—and because the sectors on the track of a diskette are contiguous, i.e., one sector adjoining the next—overrun will occur at the beginning of the second sector to be read, thereby causing the CPU to lose

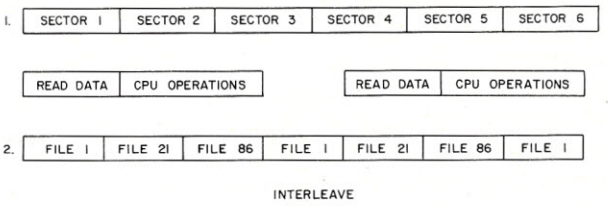


Fig. 2. File sector interleaving.

time while waiting for the diskette to make one rotation to get to the beginning of that second sector. Reading a file will become a slow and inefficient task.

This problem can be overcome if we space the sectors across the diskette and separate them by other file sectors (refer to line 2 of Fig. 2) rather than sequentially accessing sectors as illustrated in line 1. Thus, all those sectors pertaining to file 1 are spaced every third sector.

This means that when the CPU has read the information from the first sector of file 1, it can wait for the sectors of file 21 and file 86 to pass and be operating on that information before the next sector of that file is due to be read. Now instead of reading one sector per revolution of the diskette, the CPU can read eight sectors. In effect, we have increased the data transfer rate from the diskette to the system by a factor of eight times.

The industry-wide problem that is emerging is that hardware manufacturers have taken disk operating systems and developed file interleaving to suit their own purposes instead of designing to an industry standard. This presents problems to the users who often may not be using software from the same manufacturer and, therefore, are most likely running a different and incompatible interleave.

For example, a user's software may be expecting sectors spaced four apart and the diskette being read actually has sectors with file information spaced three sectors apart. Thus, software will be getting different pieces of different files and will not be able to reconstruct the complete file that the user is attempting to read. The information that results will appear to be a random collection of information rather than an ordered file.

Nonstandard Number of Sectors per Track

A third major area of concern emerging as an industry-wide problem is the actual number of sectors per track in a soft-sector format. Because a manufacturer can modify the leader preceding any sector of information, a different number of sectors can be placed on any one track of a diskette. Once again, manufacturers are developing individual internal standards to suit their specific requirements instead of designing to an accepted industry standard.

For example, some mini-floppy-based manufacturers are providing 16 sectors per track, while others are providing 18. The result is that the user is isolated, unable to be compatible with another user's system; therefore, he is without a means of efficiently exchanging information between user systems.

Advancement in State of the Art

While there appears to be no doubt that nonstandardization among manufacturers has been and continues to be the major source of incompatibility, technical advancement in the state of the art is emerging as a second major source of incompatibility that rivals it in significance. Many disk operating systems now available were designed around the single-density disk drive without the foresight that technology would very probably change, allowing much more information storage.

Indeed, two technical advancements did provide this expanded storage capability: doubled-sided drives and double-density encoding. These

advances effectively quadrupled the amount of information that could be stored in a floppy-disk system. Unfortunately, much of the then existing software could not be expanded to accommodate this increase in information.

Ideally, a disk operating system must not be limited to any specific current technology, I hope it will be flexible enough that when technology changes the software will not be instantly obsolete, as was too often the case with the introduction of double-sided drives and double-density encoding. Similarly, it will be interesting to observe what software attrition rate accompanies the probable doubling of the number of tracks per diskette side from the present 77 to 154.

In this article, we have reviewed the operation of double-density floppy-disk storage and looked at some of the major problems that are being generated in the move from single-density mode of operation to double-density, in the absence of accepted industry standards and software systems that fail to anticipate technical advancement in the state of the art.

The basic answers to these problems lie with the software operating system. Two essential characteristics for this software are: (1) that the operating system be written/designed to an industry-wide standard and, in particular, compatible with IBM for double-density and (2) that the operating system be written in such a way as to be flexible enough to provide years of service despite technical advances in hardware.

There are available to the microcomputer user several good operating systems that embrace many of the thoughts of this article. Two of these are OASIS from Phase I and FAMOS from MVT Microcomputer Systems. Both operating systems provide advance data base management facilities and hardware-independent storage of information. Thus, a user could begin his system with a floppy disk and, as his needs matured, move to a hard disk and be readily able to transfer information from the floppy-disk system to the hard disk system.

As the microcomputer industry matures, it must embrace standards as well as do its best to anticipate technical advances. These basic steps will reap rewards, not only for the authors of software because people will be buying that software for years instead of for months, but more important for the users, the people who ultimately pay the price. ■

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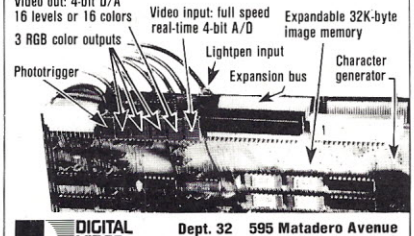
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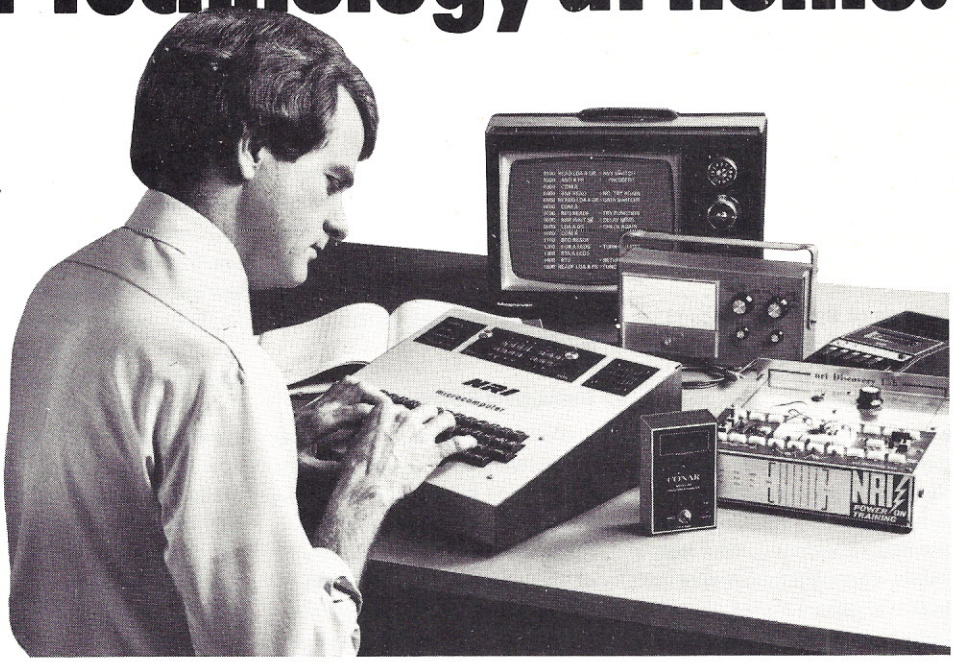
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Reader Service index—page 241

Breakpoints for North Star's Monitor

Extermination of bugs is greatly simplified when you can stop them in their tracks.

Glenn Foster
585 E. Grand Traverse
Union Lake MI 48085

One of the few really important features that North Star saw fit to omit from the software supplied with the Version 4 DOS is a means of abend debugging for machine- or assembly-language programs. It didn't take long to discover that the most common output from a newly coded program was just plain nothing . . . no flashing lights (none to flash), no core dumps (no printer, either, in my case), no cryptic messages from the DOS.

In my past decade's experience chasing bugs on one system or another, I have found that they are a great deal easier to find with a means to examine intermediate program states.

North Star provides a monitor that allows you to examine and modify memory, as well as branch to specific locations. One procedure is, therefore, to patch in a branch to the monitor at the end (middle, etc.) of a routine, then branch to the beginning. This works as long as there are no important register values on entry, and as long as the programmer is not interested in the values of the registers on exit.

Obviously, a little more is required. It might be enough to have a means to set up the registers just before branching to the start of the code under test and save the registers when returning to the monitor. It would be a nice extra if the jump and return could be accomplished by specifying two addresses to a utility routine, rather than patching in the required code. In fact, the nicest solution would be for all of this to be available from the same monitor program that provides the tools for poking about in memory.

Debugging Solutions

As it turns out, all of the above is relatively easy to accomplish. North Star provides explicit instructions to allow user additions to the command repertoire of the monitor. By patching in the ASCII value of the new two-letter command and the address at which the user code starts, almost anything that can be programmed can be added.

For example, there can be a function called BP for breakpoint, which takes two addresses as arguments, starts by filling up the registers with initial values, then jumps to the first address and allows the program under test to execute until the second address is reached. At this point, of course, the registers might be saved, and control returned to the monitor.

Branching to the first address is no trick at all. Before going, however, provision must be made for picking up all of the Z-80 registers, as well as allowing a means to get back to the monitor. Getting back to the monitor is easily accomplished by simply putting a call to the monitor at the second address, which conveniently places its ending address on the stack, preparing for the return of the original code. This leaves the registers as the only remaining problem.

```
56F0  00 00 00 00   00 00 00 00   00 00   00 00   00 00 00 00
      A  F  B  C    D  E  H  L    IX      IY      SP
```

Fig. 1.

```
?
>FM 2A00-2B00 0
>DS 2A00
2A00 00= 31  00= 00  00= 2B  00= 3E  00= 20
>BP 2A00 2A05
MONITOR VER. 1.1 (C) 1978 NORTH STAR COMPUTERS INC.
>DH 56F0,10
56F0  20 00 00 00  00 00 00 00   00 00 00 00  2B 00 00 00
>DH 2A00,6
2A00  31 00 2B 3E  20 00
>DS 2A05
2A05 00= 32  00= 03  00= 2A
>BP 2A05 2A08
MONITOR VER. 1.1 (C) 1978 NORTH STAR COMPUTERS INC.
>DH 56F0,10
56F0  20 00 00 00  00 00 00 00   00 00 00 00  2B 00 00 00
>DH 2A00,10
2A00  31 00 2B 20  20 32 03 2A   00 00 00 00  00 00 00 00
>
```

Example 1.

You could work up a sophisticated system with neatly formatted and titled displays, as well as selective modification features. Unfortunately, this would be a little bit time-consuming to program, and might well soak up more of my system's precious 16K than I would like to see dedicated to debugging.

So let's do it the easy way. If you're into machine and assembly language, you're probably already in the habit of thinking of the registers as a block of six register pairs: AF, BC, DE, HL, IX and IY. Once you develop this habit, it is easy to recognize a 16 byte hexadecimal display as AF BC DE HL IX IY SP, with two spare bytes at the end.

We've also become used to thinking of 2A00 as the normal start address of any application program, so one more address to remember should be very little trouble. If we steel ourselves to the effort of remembering the one address that is the start of a register save area, then the display and modification machinery for our registers will already be programmed. The monitor already allows us to display and modify memory.

The 16-byte trick is convenient because 16 bytes fills one line on the CRT when formatted in hex, and the hex length entered to trigger the display is 10, a nice easy pair of digits to remember.

To execute a section of code, for example, a subroutine that resides from 2ABF to 2ADE, we enter BP 2ABF 2ADE. We find ourselves back in the monitor, and the registers are available where we saved them. If the BP

function always saves its registers at 56F0, we will enter DH 56F0,10. The immediate result is a hex display of all the normal Z-80 registers, in the sequence in which we are accustomed to remembering them (see Fig. 1).

To modify a register or registers, use the DS command with the appropriate address. DS 56F0 will display the value of the (saved) A register and allow a new value to be entered. (See North Star documentation for further nuances.)

Restrictions

In the form in which I actually implemented the Breakpoint function, there are two important reservations and one nicety. The reservations are that three bytes must be, in a limited sense, available at the end of the section of code to be tested, and that the Z-80 "alternate" registers are not saved and restored by the routine.

The nicety is that the code shown makes use of some subroutines already lurking about in the North Star monitor. Specifically, with space at a premium, it seemed appropriate to "borrow" the North Star subroutines for numeric input. I found these by carefully comparing the machine code at the branch points of several other commands in the monitor.

For those who are interested, the North Star monitor is structured such that an entire command line is input from the keyboard to a buffer. Processing does not begin until the carriage return is entered. The two-character command is then found in the command table, which is described in the North Star documentation.

The monitor then branches to the address in the table. The logic for the individual command is then responsible for making appropriate calls to various input decoding subroutines, depending on the format of the specific command. The breakpoint logic makes use of a subroutine at 5D3E that picks off one address from the buffer, builds the binary value into HL and advances a pointer used by the next call to 5D3E. The delimiter that terminated the address is left in the A register, which can be tested (as simple input verification).

Both of the reservations could be eliminated by an enterprising programmer with appropriate hardware. For example, a software interrupt could be used (one byte), but this would require memory in the area from 0 to 2A00 and would require special use of this memory space.

Mine starts at 2A00 just like all "standard" Horizons, and the three-byte restriction has not been important enough to even worry about. In practice, there is almost always a suitable 3-byte long exit point near the end of any section of code I have wanted to examine . . . especially since the three bytes only have to be unused during the test execution. On return to the monitor, the original values will be replaced.

Saving the alternate registers has similarly not been a factor since I have deferred using them in lieu of a possible excursion into interrupt-driven or multi-terminal, or both, software at some future time. Addition of the necessary code to save and restore them would not, of course, be particularly difficult.

As the comments at the top of the assembly listing indicate, I chose to make the modification to the version of the monitor that has its origin at 5700. (North Star provides this as an alternate version. The "normal" monitor starts at 2A00, like most application programs.)

I did this because I usually write assembly programs with large variable-sized buffers at the end. For debugging purposes, I simply assemble the program with a smaller buffer space so it will fit below the

Breakpoint subroutine.

```
002                    * TO INSTALL, LOAD M5700 MONITOR AT 5700
003                    *   PATCH 593A TO 42,50,03,56
004                    *     SO 'BP' FROM-ADDR TO-ADDR WILL INVOKE THIS RTN
005                    *   LOAD THIS ROUTINE AT 5600
006                    *   SAVE NEW MONITOR AS M5600 FOR 10 BLKS FROM 5600
007                          ORG   :5600
008 5600 C30057              JMP   :5700
009 5603 CD3E5D              CALL  :5D3E      MONITOR RTN TO FETCH 'GO' AD
010 5606 FE20                CPI   :20
011 5608 C2585D              JNZ   :5D58      MONITOR ERR RTN IF DELIM NOT
012 560B 223756              SHLD  GOFER      PUT 'GO' ADDR INTO JMP INS.
013 560E CD3E5D              CALL  :5D3E      ...NOW FETCH BRKPT ADDR
014 5611 113956              LXI   D,INSAV
015 5614 010300              LXI   B,3
016 5617 EDB0      $         MW+R             SAVE INS FROM TEST PROG.
017 5619 2B                  DCX   H
018 561A 113C56              LXI   D,BPRET
019 561D 72                  MOV   M,D
020 561E 2B                  DCX   H
021 561F 73                  MOV   M,E        BKPT RET ADDR IN POSITION
022 5620 2B                  DCX   H
023 5621 3ECD                MVI   A,:CD
024 5623 77                  MOV   M,A        COMPLETE CALL INS AT BRKPT
025 5624 CD6656              CALL  FLPREG     REVERSE HI-LO BYTES OF REGS
026 5627 31F056              LXI   SP,RAF
027 562A F1                  POP   PSW
028 562B C1                  POP   B
029 562C D1                  POP   D
030 562D E1                  POP   H
031 562E DDE1      $         POP   X
032 5630 FDE1      $         POP   Y          ALL REGS SAVED IN NAMED LOCS
033 5632 ED7BFC56  $         LSPD  RSP        RESTORE SP
034 5636 C3                  DATA  :C3
035 5637 0000        GOFER   DBL   0
036 5639 00          INSAV   DATA  00
037 563A 00                  DATA  00
038 563B 00                  DATA  00
039 563C ED73FC56  $ BPRET   SSPD  RSP        START BY SAVING SP
040 5640 31FC56              LXI   SP,RSP     N.B. FRST PSH @RSP-1
041 5643 FDE5      $         PSH   Y
042 5645 DDE5      $         PSH   X
043 5647 E5                  PSH   H
044 5648 D5                  PSH   D
045 5649 C5                  PSH   B
046 564A F5                  PSH   PSW
047 564B ED7BFC56  $         LSPD  RSP        RESTORE SP FROM TEST PROG.
048 564F D1                  POP   D          ADDR AFTER B.P. CALL TO MON
049 5650 ED73FC56  $         SSPD  RSP        'REAL' SP OF PROG UNDER TEST
050 5654 1B                  DCX   D
051 5655 213B56              LXI   H,INSAV+2
052 5658 010300              LXI   B,3
053 565B EDB8      $         MW-R             RESTORE INST. AT BRKPT
054 565D 31F85E              LXI   SP,:5EF8   MONITOR'S INTERNAL STACK
055 5660 CD6656              CALL  FLPREG
056 5663 C30057              JMP   :5700
057 5666 0607        FLPREG  MVI   B,7
058 5668 ED737E56  $         SSPD  SPSAV
059 566C 31F056              LXI   SP,RAF
060 566F 21F056              LXI   H,RAF
061 5672 D1          REGLP   POP   D
062 5673 73                  MOV   M,E
063 5674 23                  INX   H
064 5675 72                  MOV   M,D
065 5676 23                  INX   H
066 5677 10F9      $         DBNZ  REGLP
067 5679 ED7B7E56  $         LSPD  SPSAV
```

```
068 567D C9                 RET
069 567E 0000       SPSAV   DBL   0
070 5680            EORTN   RES   :56F0-EORTN TO STABILIZE REG SAVE AREA
071 56F0 0000       RAF     DBL   0
072 56F2 0000       RBC     DBL   0
073 56F4 0000       RDE     DBL   0
074 56F6 0000       RHL     DBL   0
075 56F8 0000       RIX     DBL   0
076 56FA 0000       RIY     DBL   0
077 56FC F056       RSP     DBL   RAF       ENOUGH STACK TO GET BACK
078 56FE                    END

**************************
* S Y M B O L   T A B L E *
**************************

GOFER  5637   BPRET  563C   FLPREG 5666   INSAV  5639
REGLP  5672   EORTN  5680   RAF    56F0   RBC    56F2
RDE    56F4   RHL    56F6   RIX    56F8   RIY    56FA
RSP    56FC   SPSAV  567E
```

monitor. When it is ready for production, I use a final assembly with a larger buffer space declared. (Under most conditions, larger buffers mean faster execution.)

The modified monitor has its entry at 5600, providing 256 bytes for the breakpoint logic. The register save area is forced to address 56F0 (the last 16 words of the new block of code), so it will remain constant even if the breakpoint routine is later modified. ■

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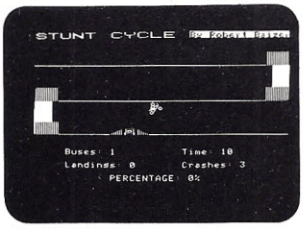
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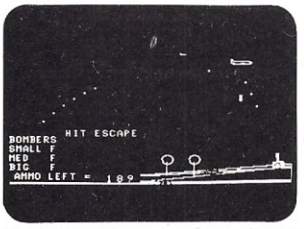
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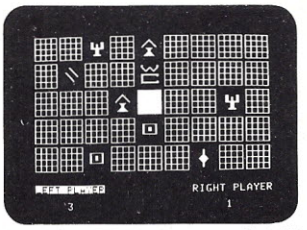
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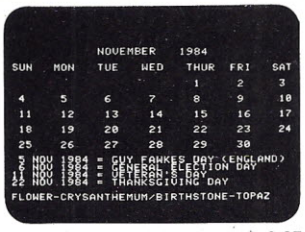
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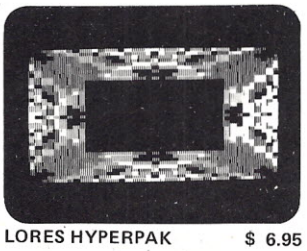
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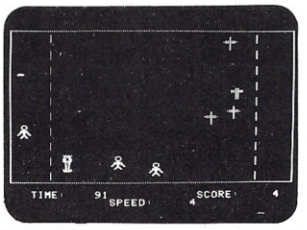
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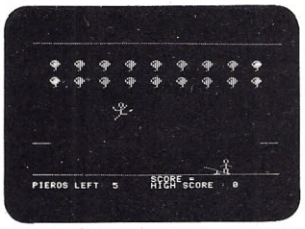
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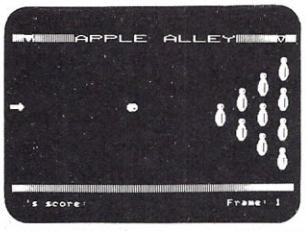
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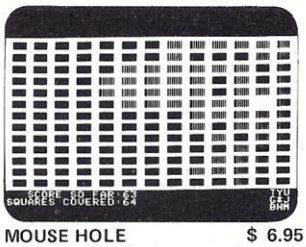
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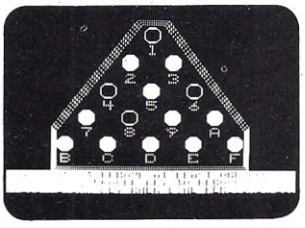
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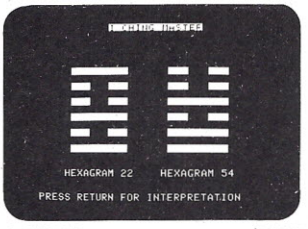
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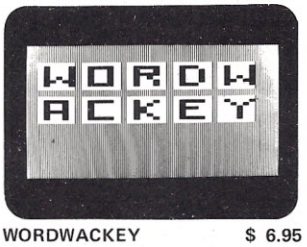
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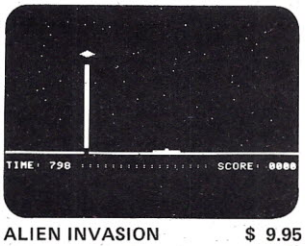
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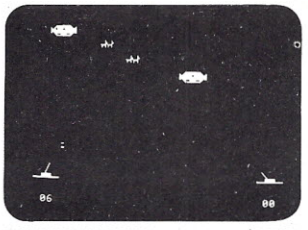
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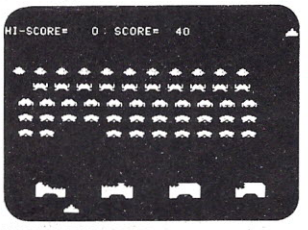
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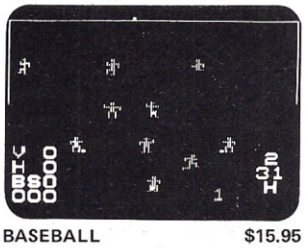
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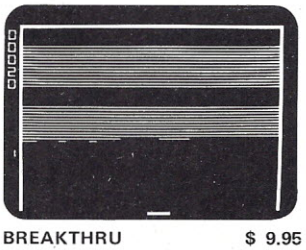
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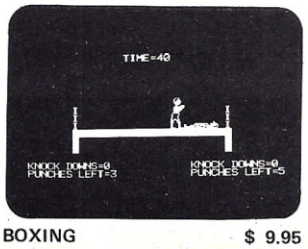
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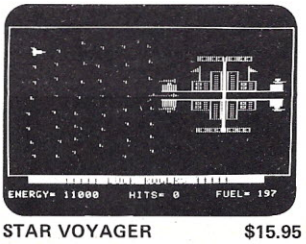
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One of the nice things about having a microcomputer is that you can do high-speed mathematics. An Apple II, for example, does a nine-digit floating point division in AppleSoft in about 4 1/2 ms. There may be occasions, however, when you are either not satisfied with the speed of AppleSoft or cannot use it for some reason. If you owned any other computer, you would have to start looking for assembly-language programs that allowed you to work with floating point numbers. Not so with the Apple II.

A versatile, but little known, feature of the Apple II is the set of floating point routines—machine-language programs in ROM (starting at hexadecimal $F425) that do floating point arithmetic on four-byte floating point numbers. These routines have been given little attention because (1) little documentation is supplied with the machine other than the assembly-language listing on page 94 of the Apple II reference manual, and (2) the answer is difficult to decipher—the required normalization in a hex format makes the representation of the number extremely abstract. It is disconcerting to find that the number two is represented as 81 40 00 00.

Nevertheless, these routines can be extremely useful in at least two areas: high-speed number crunching, if you can interpret the result . . . that's what this article is about, and high-speed graphics, which requires some input, then a high-speed calculation of floating point numbers resulting in screen points that are integers. Then the Apple HIRES routine can be used to plot the points.

There is one catch: if your program uses assembly language only, then you are free to use the floating point (FP) routines as they are in ROM. However, if you wish to mix Integer BASIC and assembly language, you will have to reassemble the FP routines into RAM somewhere and change the working registers to somewhere very low in zero page of memory (for example, the "sweet 16" area). This is because Integer BASIC appropriates the area used by the FP routines ($F4 to $FB).

For high-speed graphics, I write an assembly-language subroutine that does all the number crunching using the floating point routines. Then I use the FIX function (explained later), which conveniently transforms the floating point number into a 2 byte signed two's complemented integer (also explained later), which happens to be the same format that Integer BASIC uses. Then, I can shove those two bytes into a memory location of some Integer BASIC variable (just as the HIRES routines do); I can now plot the point or print the value using the BASIC print statements. (See the Apple II reference manual, pp. 34-39, particularly Fig. 3 on p. 39.)

The upshot of all this is that you can now do high-speed number crunching with high-speed HIRES graphics under the control of a fast Integer BASIC! The possibilities opened up by this are unlimited. The capability of the Apple for simulation or real-time applications is enhanced considerably.

This article will give you an introduction to these floating point routines and their use.

The Floating Point Format

What follows contains a lot of strange-looking numbers. Do not let that upset you. That you have read this far means you are interested. If you read carefully, you'll find that everything is explained and that it isn't all that hard.

Actually, the format of the floating point numbers is an old idea; it is just new to today's microcomputerist. Four bytes are used to represent a number: one byte is used for the exponent and the other three form the mantissa. Since three bytes

Binary Exponent Written in Hex	Decimal Equivalent
00	−128
01	−127
.	.
.	.
.	.
7F	−1
80	0
81	+1
.	.
.	.
.	.
FE	+126
FF	+127

Table 1.

01111010	01000000	00000000	00000000	binary
122	64	00	00	decimal
7A	40	00	00	hex

Example 1.

contain 24 bits, you have 24 binary digits of precision.

In order to find out how many decimal digits this is, we write

$2^{24} = 10^N$

where N is an unknown to be found. We next take the log of both sides (natural or common, it doesn't matter) and use the equation $\log(a^b) = b \log a$.

$$\log(2^{25}) = \log(10^N)$$
$$24 \log 2 = N \log 10$$
$$N = \frac{24 \log 2}{\log 10}$$
$$= 7.2$$

So we can represent a number of about seven decimal digits with 24 binary bits. However, since we use floating point numbers, we can have a number with about seven digits of precision times an exponent. This allows us to store much larger (and smaller) numbers.

First, let's look at the exponent. With one byte for the exponent, we can represent 2^8, or 256, different numbers. These are the powers of 2, and the format is selected so that there is no need for a sign bit. Instead, the exponents are in the range of -128 to $+127$ (decimal) represented as 00 through FF (hex). That is, the smallest characteristic is 2^{-128} (about 10^{-38}) and the largest is 2^{+127} (again, about 10^{+38}). Table 1 should make this clear.

Next, the mantissa. The number is normalized so that the leftmost two bits are 01 for a positive mantissa and 10 for a negative mantissa. The binary point (BP) is considered to be just to the right of these two leftmost bits. For example, a positive number might be

01.XXXXX...

where the Xs are any combination of 1s and 0s. A negative number would look like

10.XXXXX...

Of course, the binary point is implied and not stored in the bit string. We keep track of it by the normalization.

This normalization process is similar to what we do for ordinary decimal numbers in scientific notation. Given

0.01×10^{-3} (base ten)

we can multiply the mantissa by 100 and divide the characteristic by 100 to keep the number unchanged:

$1. \times 10^{-5}$ (base ten)

Notice that no zeros were filled in because we really didn't know what was after the 1 in the first number. By convention, we fill in with trailing zeros.

A binary example of the normalization is

$0.001_2 \times 2^{-3}$ (base two)

(This should really be written:

$0.001_2 \times (10)_2^{-011}$

where $(10)_2 = 2_{10}$ in order to eliminate decimal numbers from the binary representation. Take your choice.) Again, we multiply by a suitable power of the base, in this case 2^3, to obtain:

$01.0_2 \times 2^{-6}$ (base two)

The mantissa is properly normalized since it starts with 01. the exponent is -6_{10}, which converts 7A. For presentation purposes, we use the convention that the leftmost byte is the exponent and the mantissa has the most significant byte on the left. This number, which is, by the way, 1/64 base ten, is represented as shown in Example 1.

So the floating point equivalent of 1/64 is 7A 40 00 00. For negative numbers, we would have two's-complemented the mantissa before normalization.

	FP1					FP2		
248	249	250	251	decimal address	244	245	246	247
F8	F9	FA	FB	hex address	F4	F5	F6	F7
X1	M1	M1+1	M1+2	assembly mnemonic	X2	M2	M2+1	M2+2
EXP	high		low	contents	EXP	high		low
		Mantissa					Mantissa	

Table 2. Floating point registers.

Function	Mnemonic	Number(s) In	Call Location	Result In
Negate	FCOMPL	FP1	F4A4	FP1
Add	FADD	FP1 + FP2	F46E	FP1
Subtract	FSUB	FP1 − FP2	F468	FP1
Multiply	FMUL	FP1 × FP2	F48C	FP1
Divide	FDIV	FP2/FP1	F4B2	FP1
Float	FLOAT	16 bit integer in M1 & M1+1 (M1+2 cleared)	F451	FP1
Integer	FIX	FP1	F640	16 bit integer in M1 & M1+1

Table 3. Floating point arithmetic routines.

The Floating Point Routines

Now that you see how the floating point numbers are represented, it's time to look at the routines that operate on them. The subroutines operate on one or two registers (depending on whether the function is monadic or dyadic) called FP1 and FP2. These reside in page zero of memory. Their location and contents are shown in Table 2.

To use the routines, load the proper registers with the floating point number(s) and call the proper routine. See Table 3 for

Glossary

Absolute Value: The value of a number without regard to the sign of the mantissa. ABS(−3) = 3.

Binary Point: The analog to the decimal point which indicates the separation between the zeroth power of the base and the −1 power. Hence, $10.1_2 = 2.5_{10}$

Characteristic: A leftover term from slide rules. It is useful to describe the value of $10^{\pm N}$ or $2^{\pm N}$.

Dyadic Function: A function that requires two arguments (inputs). Addition is a dyadic function.

Floating Point: A number representation that uses an N bit mantissa presumed to be multiplied by a characteristic.

Mantissa: The first multiplier of a number in scientific notation. In 2×10^6, the 2 is the mantissa; 10^6 is the characteristic; and 6 is the exponent.

Monadic Function: A function that requires only one argument (input). The log is a monadic function.

Normalization: The process whereby a number in scientific notation is adjusted so that the mantissa lies in a certain range. For decimal numbers, usually $1 \leqslant M < 10$; for binary, $1/2 \leqslant M < 1$.

Precision: A measure of the number of digits that can be represented. 1001 has four digits of precision. It is another name for significant digits.

Two's Complement: A method of representing negative binary numbers. First, all 0s are made 1s, and all 1s are made 0s. Then 1 is added. For example, 4 is 00000100. The two's complement is 11111100.

Zero Page: The first 256 memory locations addressable by the computer. Used extensively by the firmware.

Type	Then Hit	Comments
F4:83 60 00 00	RETURN	Put 12 in FP2
F8:82 40 00 00	RETURN	Put 4 in FP1
F4B2G	RETURN	Execute routine at F4B2
F8.FB	RETURN	Examine contents of FP1

Example 2.

If the Format Is	Then
1) 0.00XXX	Move BP right until you get 01.XXX; E = – RN
2) 0.01XXX	Move BP right two places to get 01.XXX; E = –2
3) 0.10XXX	Move BP right one place to get 01.0XXX; E = –1
4) 0.11XXX	Move BP right one place to get 01.1XXX; E = –1

where RN is the number of places moved to the right.

Example 3.

If the Format Is	Then
1) 1.11XXX	Move BP right until you get 10.XXX; E = – RN
2) 1.10XXX	Move BP right two places to get 10.XXX; E = –2
3) 1.01XXX	Move BP right one place to get 10.1XXX; E = –1
4) 1.00XXX	Move BP right one place to get 10.0XXX; E = –1

where RN is the number of places moved to the right.
(Note: Even though the number is less than 1, in two's complement, the leading 0 becomes a 1).

Example 4.

the format.

For example, to divide 12 by 4, hit RESET. If you have AppleSoft in ROM, be sure the switch is down, then hit RESET. Example 2 shows you what to type. You will then see 81 60 00 00, which is decimal 3.

The Algorithm

If you wish to write a program that utilizes these routines, you will have to have two tools: a short assembly-language program that will move data in and out of the FP registers and a precise algorithm for translating decimal numbers into the floating point format. As you will see, this is a tedious process for more than a couple of numbers. The algorithm is as follows:

1. Write down the number in decimal; call it N.

2. Convert to binary, ignoring the sign of the mantissa.

3a. If the absolute value of N is less than 1, then keep only the leftmost 24 significant digits, that is, ignoring leading zeros.

3b. If the absolute value of N is greater than 2^{24}, record the location of the binary point and keep only the leftmost 24 digits.

4. Eliminate the binary point after noting its location.

5. If the mantissa is negative, two's-complement it.

6a. If N is positive and ≥1, shift the binary point to the left (if necessary) until there is only one leading zero, that is, the leftmost bits are 01. (If necessary, add a leading zero.) Lop off any bits before the 01 and fill out to the right with zeros to make up 24 bits. The number of place shifts is the binary exponent + E.

6b. If N is positive and <1, then do one of the operations in Example 3.

6c. If N is negative and the absolute value of N≥1, shift the binary point to the left until the leftmost bits are 10 and add trailing zeros to make up 24 bits. The number of place shifts is the exponent + E. (Exception: If all 1s are to the left of the decimal, shift the binary point to the right one place. Lop off any leading 1s prior to the 1X and add trailing zeros to make up 24 bits. The exponent E = – 1.)

6d. If N is negative and the absolute value of N<1, then do one of the operations in Example 4.

7. Convert the three groups of 8 bits to decimal (as an intermediary, if you wish) then to hex, ignoring the binary point.

8. The exponent is $80_{16} + E_{16}$. See Examples 5 and 6.

After you have done this for a number such as 2.371256×10^{-26}, you will wish there were a way to get the Apple itself to do the work. I thought the same way myself after I had to do several of them, so I wrote an AppleSoft program to do it for me. (Ideally, it would be an assembly-language program, but that's a lot of work. And the AppleSoft program gives the answer in a few seconds.)

This program accepts either decimal input and outputs the floating point format or accepts the floating point format and generates the decimal number. It runs in 5.8K, so if you only have AppleSoft II on cassette, you'll need a 20K or larger machine. The program is available on cassette for $7 ppd.

There is one additional note. Just as Integer BASIC appropriates zero page for its use, so does AppleSoft—so you cannot call these routines from AppleSoft. You could shuffle data in and out of the registers preserving their status before and after each call, or, as mentioned before, you could reassemble the FP routines into RAM and have

Number (Absolute Value)	Floating Point (Positive)	Representation (Negative)
0	00 00 00 00	00 00 00 00
10^{-10}	5E 6D F3 7F	5E 92 0C 81
10^{-5}	6F 53 E2 D6	6F AC 1D 2A
.01	79 51 EB 85	79 AE 14 7B
.2	7D 66 66 66	7D 99 99 9A
.25	7E 40 00 00	7D 80 00 00
.75	7F 60 00 00	7F A0 00 00
.9	7F 33 33 33	7F 8C CC CD
1	80 40 00 00	7F 80 00 00
2	81 40 00 00	80 80 00 00
3	81 60 00 00	81 A0 00 00
4	82 40 00 00	81 80 00 00
5	82 50 00 00	82 B0 00 00
6	82 60 00 00	82 A0 00 00
7	82 70 00 00	82 90 00 00
8	83 40 00 00	82 80 00 00
9	83 48 00 00	83 B8 00 00
10	83 50 00 00	83 B0 00 00
10^5	90 61 A8 00	90 9E 58 00
10^{10}	A1 4A 81 7C	A1 B5 7E 84

Table 4. Some floating point numbers. Note that the positive and negative numbers should add to zero, which they do.

Step Number	Result
1.	+ 12
2.	1100.
6a.	01.10000000000000000000
	E = 3
7.	01100000 00000000 00000000
	96 00 00
8.	Exponent = 83

The number is 83 60 00 00 when converted to hex.

Example 5. Using + 12.

Step Number	Result
1.	– 12
2.	1100.
5.	. . . 1111111110100
6c.	10.10000000000000000000
	E = 3
7.	01100000 00000000 00000000
	160 00 00
8.	Exponent = 83

The number is 83 A0 00 00 when converted to hex.

Example 6. Using – 12.

them use different zero page registers. There is room in zero page to do this with Integer BASIC, but precious little with AppleSoft. I haven't done it yet.

Also, AppleSoft does not use these routines for its own arithmetic. The reason for this is that Microsoft BASIC uses a *five* byte floating point number in order to obtain nine-digit precision. This came along after the FP routines were written. Furthermore, the numbers are stored in those five bytes in a different format (ASCII) than that used by the FP routines.

Conclusion

The floating point routines are useful for the assembly-language programmer. There are special occasions when the difficulty of their use is secondary to the advantage of an assembly-language program with seven digits of precision.

This article has shown how to get the numbers into the required format. (However, you should not try to use the routines extensively without consulting the references on error branching and index register use.) Finally, Table 4 lists some floating point numbers for you to practice on with the algorithm and the routines. ■

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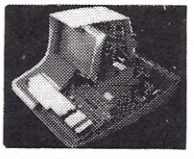
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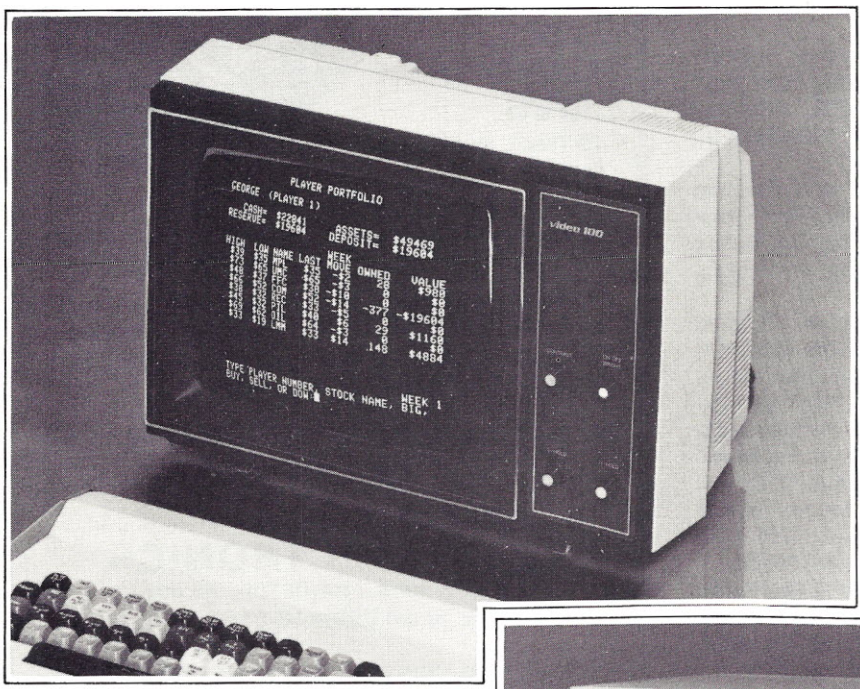
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✓M111

✓ Reader Service index—page 241

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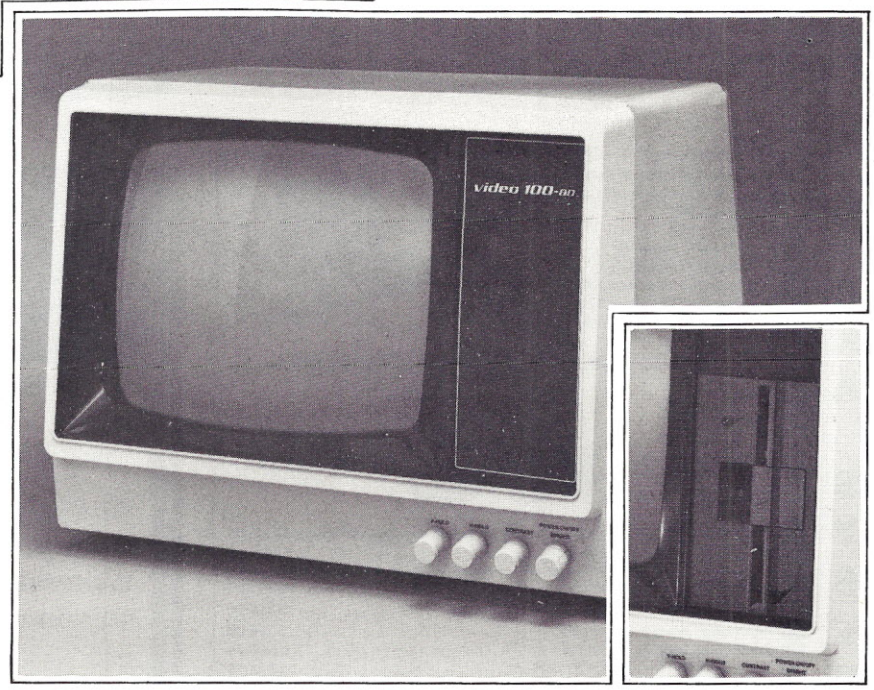
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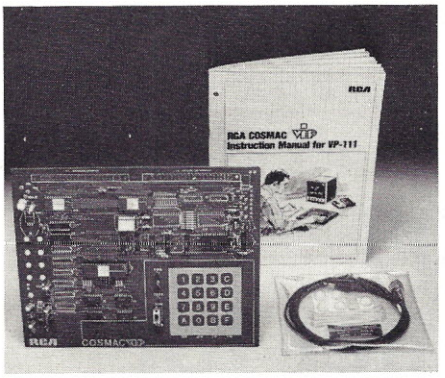
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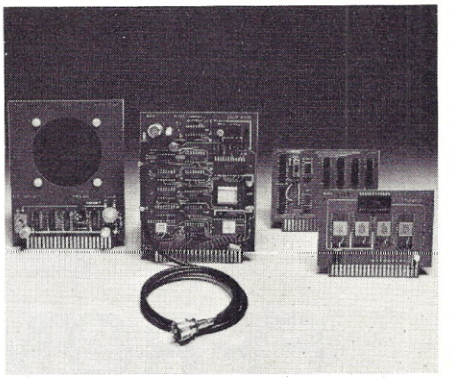
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✓ Reader Service index—page 241

A Simple 2708 EPROM Programmer for the Motorola D2 Kit

Add 2K of firmware using a handful of components that fit right on the D2 board.

Frank W. Summers
Motorola Microsystems
514 E. Carmen St.
Tempe AZ 85283

Add up to 2K bytes of programmable memory to your Motorola MEK6800-D2 kit with this simple, low-cost 2708 EPROM programmer. Requiring only three transistors, six resistors, four capacitors and two switches, it can be assembled right on the D2 kit printed circuit board for approximately $7.

The reason for using the 2708-type EPROM is simple—its cost. The newer, larger, single supply EPROMs are too expensive for most home computer users. The 2708 type (with its +5 V, +12 V and −5 V requirement) is available to the hobby user for less than $10. The fact that the D2 kit has two EPROM sockets available for 2708s makes this a natural matchup. Just think, you can buy a D2 kit and add this programmer for less than the cost of many programmers alone!

Don't worry about investing in an expensive ultraviolet EPROM eraser, because most local computer stores offer this service for a small fee. If this isn't convenient, you can build an EPROM eraser for less than $20 using a germicidal lamp (G.E. #G8T5) and a suitable fixture. If you try this be sure to follow the precautions that come with the lamp about exposure to ultraviolet radiation.

Circuit Description

Only a brief description of the circuit is offered because it is simple. The +27 V for the programming pulse is supplied from three 9 V batteries connected in series. Since the current required from these batteries is only 20 mA and only during the actual programming of a device, the shelf life of the batteries will probably determine their usage. The power switch (S1) will remove the +5 V and +12 V from the EPROM socket and disconnect CB2 of PIA U21. When the EPROM socket is empty and S1 is off, there is nothing connected to the PIAs so they can be used for other applications.

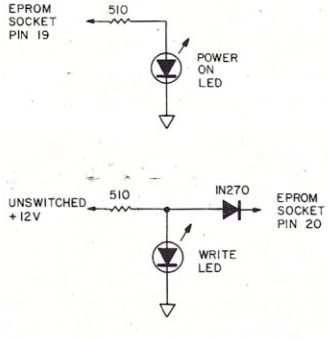


Fig. 1. Optional LEDs to indicate Power On and Write mode.

The read/write switch (S2) applies ground to pin 20 ($\overline{CS}$/WE) and removes the ground from the +27 V source when in the read position. When in the write position pin 20 ($\overline{CS}$/WE) is pulled up to +12 V through a 10k resistor (R1) and the ground is applied to the +27 V source. This allows programming pulses to be applied to pin 18 (PROG) through transistor Q1 as controlled by CB2 of the PIA (U21 of the D2 kit).

The two 100 Ohm resistors (R4 & R5) balance the base drive to Q2 and Q3. The 10 Ohm resistor (R6) and the .005 uF capacitor (C4) limit the rise-and-fall time of the +27 V programming pulse to the EPROM. All data to and from the EPROM is through the B side of the user PIA (U20 of the D2 kit). The addressing for the EPROM is from the A side of the user PIA (U20 of the D2 kit), plus CA2 and CB2 for address lines A8 and A9, respectively.

Programming

The software to operate the programmer requires 375 bytes of memory and supplies these four functions:

1. PROGRAM—programs the EPROM from the memory locations specified.
2. VERIFY—compares the EPROM with the memory locations specified.
3. DOWNLOAD—copies the EPROM into the RAM locations specified.
4. ERASED?—checks that the specified EPROM locations are erased.

The only inputs required for all of these operations are: (1) starting memory address, (2)

ending memory address and (3) EPROM address offset. Once these parameters are entered they will remain the same until changed by the user.

When any function is started these addresses are checked for proper range. The function is stopped and error message E0 is displayed if the difference between the ending and starting address is greater than 1024. If adding the EPROM offset to this difference exceeds 1024, error message E1 is displayed; error message E2 indicates that the EPROM address tried to exceed 1024 while the program function was executing.

Obviously this should never happen unless the programmer program itself bombs. Error message E3 indicates that the EPROM and specified memory locations didn't agree during the VERIFY function. Error message E4 indicates an unerased location was found in the specified EPROM locations during the ERASED function. The return of the JBUG prompt "-" to the display means the designated function has completed with no errors.

A programming pulse of one millisecond duration is applied for each EPROM address to be programmed. If less than 1024 locations are being programmed, enough delay is added to simulate programming the entire device. This routine is repeated 100 times to give each location a total of 100 milliseconds programming time. This limits the duty cycle of any one location as specified in most manufacturers' data books.

The programming time will be about two minutes whether programming 1 byte or 1024 bytes. This feature allows you to safely program an EPROM in short blocks, adding routines or entire programs as desired without erasing and reprogramming the entire device each time. Also, you can safely program the entire EPROM from a small RAM area by putting each successive block of code in RAM and programming the appropriate block of EPROM.

Another safety feature is that the D2 kit's keyboard is disabled while programming to avoid the possibility of the escape key being pressed and leaving the +27 V applied to the EPROM.

The delay routine is for a system clock frequency of 614.4 kHz. If your system has a different clock frequency, the number of counts in the delay loop will have to be adjusted accordingly. (Change location $00A9 to $A6 for 1 MHz.)

Test Procedure

So now you have the 2708 programmer circuit added to your D-2 kit and the software typed in. Before you do anything else you should save the program on tape. That done, you can use the following test procedure to verify the circuit and the program before plugging an EPROM into the socket. All you will need is a VOM, a watch with a second hand and a 2708 EPROM.

First check that the −5 V is on pin 21 of the EPROM socket. Then check for the +12 V on pin 19 and +5 V on pin 24 . . . make sure they are switchable with S1. Pin 20 should have +12 V when the read/write switch is on write and 0 V when in the read position. To check the +27 V on pin 18 the program will have to be temporarily changed. Change location $0035 from $8D to $3E. This is the WAI (wait for interrupt) instruction and will stop program execution at this point.

With the power switch on and the read/write switch set to write, the voltage on pin 18 should be 0 V. Referring to the operating instructions, start the PROGRAM mode with the first, last and EPROM offset addresses set to $0000. The voltage on pin 18 should now be between +25 V and +27 V. Switch back to read, and the voltage on pin 18 should drop to 0 V. Hit reset, restore location $0035 to $8D and turn the power switch off.

Now you will need some known data patterns to write to the EPROM socket for verification. Starting at location $0178 store $FF, $00, $55 and $AA. Set the first address to $0178 and the last address to $017B. You are now set up to simulate

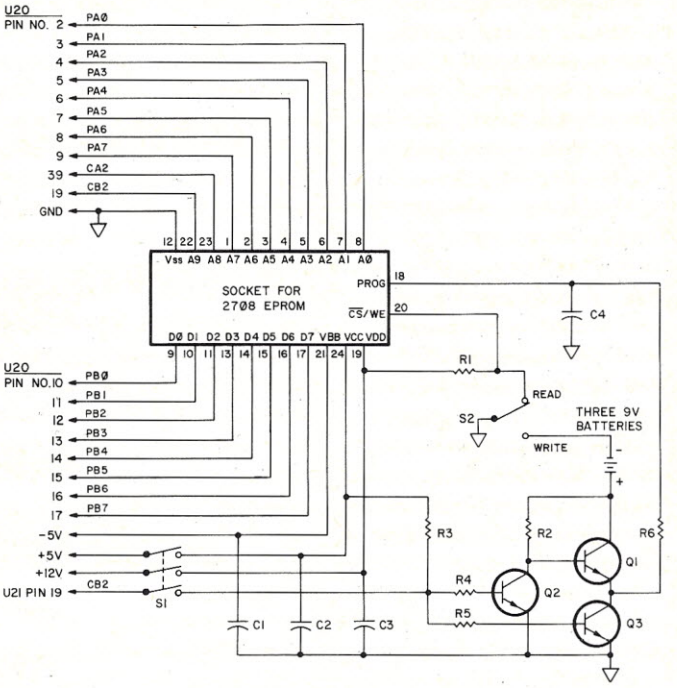


Fig. 2. Schematic of 2708 EPROM programmer for D2 kit.

programming these four bytes to the first four locations of the EPROM.

Set a breakpoint at $0030 and start the PROGRAM mode. All address lines of the EPROM socket should now read a logical 0 level (less than 0.5 V). All data lines should read a logical 1 level (more than 3.0 V). Continue program execution to the breakpoint again by typing E then G. Now address line A0 should read a 1 level; A1 through A9 should read a 0 level; and the data lines should all read a 0 level. Type E and G again and you should read a 1 level on A1, a 0 level on all other address pins, and the data lines should be alternate 1s and 0s (D0 = 1, D1 = 0, etc.).

Continue once more to the breakpoint and the results should be: A0 and A1 at a 1, all other address lines at 0, and the data lines alternate 0s and 1s (D0 = 0, D1 = 1, etc.). That's it for the data lines. Hit E, set the EPROM address offset to $0155 and start the PROGRAM mode again. The address lines at the EPROM socket should now be alternate 1s and 0s (A0 = 1, A1 = 0, etc.). Push E, set the EPROM address offset to $02AA and start the PROGRAM mode again. The address lines should now be alternate 0s and 1s (A0 = 0, A1 = 1, etc.). Clear the breakpoint and hit reset.

You can make a check of the loop counter by setting a breakpoint at $0068 and executing the PROGRAM mode. Now push the E key and the G key 100 times. This should cause the "-" to appear on the display in-

Q_1, Q_2, Q_3	2N4401 or equivalent
S_1	3PST toggle switch
S_2	SPDT toggle switch
C_1, C_2, C_3	.1 uF, ±20% ceramic capacitor
C_4	.005 mfd, ±20% ceramic capacitor
R_1, R_2, R_3	10k Ohm, ±10% 1/4 Watt carbon resistor
R_4, R_5	100 Ohm, ±10% 1/4 Watt carbon resistor
R_6	10 Ohm, ±10% 1/4 Watt carbon resistor
MISC.	24-pin socket for EPROM, three 9 V batteries, battery clips and battery holders.

Parts list.

dicating that the program has completed executing. Clear the breakpoint and push reset.

Now that you know the loop counter is operating correctly, you can verify the delay loop that sets the pulse width of the +27 V programming pulse by timing the execution of the PROGRAM mode with your watch. With the first, last and EPROM offset addresses set at $0000, execution of the PROGRAM mode should take about one minute and 25 seconds. Change the last address to $03FF (1024) and execution time should be about two minutes.

The next text can be performed using the DOWNLOAD function and an EPROM with a known program or an erased one. First clear memory locations $0177 through $017F by storing $00 to each location. Set the first address to $0179 and the last address to $017C. Plug the EPROM in, turn power on and execute the DOWNLOAD function.

When the "-" returns to the display, read locations $0177 through $017F. Locations $0179-$017C should contain the first four bytes of the program in the EPROM ($FF if erased). Locations $0177, $0178, $017D, $017E and $017F should still contain $00. Now run the VERIFY function without changing anything, and the "-" should return indicating that EPROM and RAM contents for those four locations match. If you have a 2708 with a known program, try a different EPROM address offset and see that the correct data appears in $0179-$017C.

If everything works so far you are on your way. It is left up to you to try illegal addresses and to check the ERASED function.

Operating Instructions

A. To program an EPROM:

1. The program to be put in EPROM must be in memory at a location other than that where the PG2708 program is.
2. Load PG2708 from cassette (if not in EPROM).
3. Reset.
4. Load the first address of your program at $A032-3.
5. Load the last address of your program at $A034-5.
6. Load the EPROM address offset $A036-7.
7. Make sure the EPROM power switch is off and the Read/Write switch is on read.
8. Plug the 2708 into the programmer socket.
9. Turn the EPROM power switch on.
10. Turn the Read/Write switch to write.
11. Type 0000G to execute the PROGRAM function.
12. When the "-" returns to the display, push Reset and then turn the Read/Write switch to read.
13. Type 0003G to VERIFY that the EPROM was programmed correctly.
14. Turn the EPROM power switch off and remove the 2708.

B. To download an EPROM to RAM:

1. Load PG2708 from cassette (if not in EPROM).
2. Reset.
3. Load the first RAM address at $A032-3.
4. Load the last RAM address at $A034-5.
5. Load the EPROM address offset at $A036-7.
6. Make sure the EPROM power switch is off and the Read/Write switch is on read.
7. Plug the 2708 into the programmer socket.
8. Turn the EPROM power switch on.
9. Type 0006G to execute the DOWNLOAD function.
10. Turn the EPROM power switch off and remove the 2708.

C. To verify that EPROM and memory agree:

1. Load PG2708 from cassette (if not in EPROM).
2. Reset.
3. Load the first memory address at $A032-3.
4. Load the last memory address at $A034-5.
5. Load the EPROM address offset at $A036-7.
6. Make sure the EPROM power switch is off and the Read/Write switch is on read.
7. Plug the 2708 into the programmer socket.
8. Turn the EPROM power switch on.
9. Type 0003G to execute the VERIFY function.
10. The "-" returns to the display if the EPROM and memory agree.
11. Turn the EPROM power switch off and remove the 2708.

D. To check that a designated section of the EPROM is erased:

1. Load PG2708 from cassette (if not in EPROM).
2. Reset.
3. Load a first* memory address at $A032-3.
4. Load a last* memory address at $A034-5.

*(These can be any block of memory—they are used only to determine how many EPROM locations to check.)

5. Load the EPROM address offset at $A036-7.
6. Make sure the EPROM power switch is off and the Read/Write switch is on read.
7. Plug the 2708 into the programmer socket.
8. Turn the EPROM power

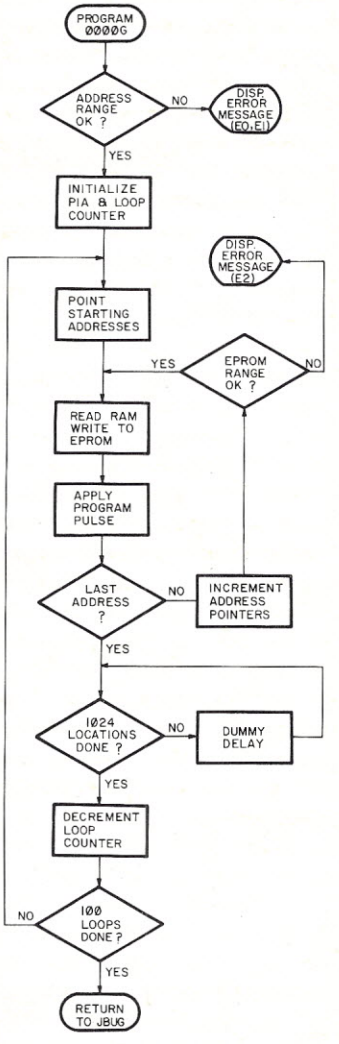


Fig. 3. PROGRAM mode flowchart.

Program listing.

```
00001                    TTL    MCM2708 EPROM PROGRAMMER FOR D-2 * REV. 2.2
00002A 0000              ORG    $0000
00003    ****************************************************
00004    *
00005    ***** MCM2708 EPROM PROGRAMMER BY FRANK SUMMERS *****
00006    *
00007    ****************************************************
00008    *
00009    * NO FUNCTIONAL CHANGES THIS REVISION.
00010    * CORRECTED LOCATION COUNTER INITIALIZATION.
00011    *
00012    ****************************************************
00013    * THIS ROUTINE WILL PROGRAM THE MOTOROLA MCM2708,
00014    * MCM68708, OR MOST OTHER 2708 TYPE EPROMS ON A
00015    * MOTOROLA MEK6800D-2 SINGLE BOARD COMPUTER (D2 KIT)
00016    *
00017    * 375 BYTES OF MEMORY IS REQUIRED FOR THIS PROGRAM.
00018    *
00019    * THE SIMPLE EPROM PROGRAMMER CIRCUIT (ATTACHED)
00020    * CAN BE ASSEMBLED ON THE D-2 KIT PCB OR CAN BE
00021    * BUILT SEPARATELY AND CONNECTED WITH A CABLE.
00022    *
00023    * NOTE THAT THE 2708 REQUIRES +5V, +12V, & -5V.
00024    *
00025    * THE +27V PROGRAMMING PULSE IS SUPPLIED BY THREE
00026    * 9V BATTERIES.
00027    *
00028    * 100 27V PULSES OF ONE MSEC DURATION ARE APPLIED
00029    * FOR EACH EPROM ADDRESS TO BE PROGRAMMED.
00030    *
00031    * THE KEYBOARD IS DISABLED TO PREVENT ACCIDENTALLY
00032    * HITTING "ESCAPE" & LEAVING THE +27V APPLIED.
```

switch on.

9. Type 0009G to execute the ERASED? function.

10. The "-" returns to the display if the designated EPROM locations are erased and ready for programming.

11. Turn the EPROM power switch off and remove the 2708.

Two or more of these functions are usually used together. For example, to copy an existing 2708 you will first DOWNLOAD it into RAM, VERIFY that it is stored correctly, check that the new 2708 is ERASED, PROGRAM the new 2708 and finally VERIFY that the program is in the new 2708. All of these operations can be performed after the address information is loaded only once. You should always use VERIFY immediately after a DOWNLOAD or a PROGRAM operation. Also, you should always check that an EPROM is ERASED before trying to PROGRAM it. (Even new EPROMs are not always erased!)

Error Messages

If E0 or E1 appears on the display (indicating out of range addresses), check the first, last and offset addresses at $A032-$A037. E0 means the last address minus the first address is

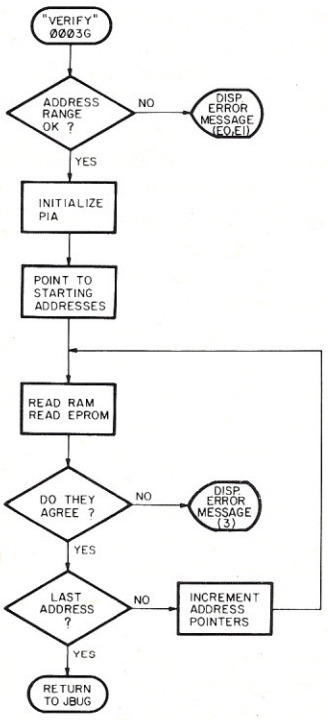


Fig. 4. VERIFY mode flowchart.

```
00033                    *
00034                    * IF LESS THAN 1024 LOCATIONS ARE BEING PROGRAMMED
00035                    * ENOUGH DELAY IS ADDED TO KEEP THE DUTY CYCLE
00036                    * LOW TO EACH LOCATION PROGRAMMED.
00037                    *
00038                    * THE FOUR MODES OF OPERATION ARE:
00039                    *
00040                    * 1. PROGRAM ($0000) PROGRAMS THE EPROM FROM RAM.
00041                    *
00042                    * 2. VERIFY ($0003) VERIFIES THAT EPROM & RAM AGREE.
00043                    *
00044                    * 3. DOWNLOAD ($0006) READS EPROM INTO RAM.
00045                    *
00046                    * 4. ERASED ($0009) VERIFIES THAT EPROM IS ERASED.
00047                    *
00049                    ********** OPERATING INSTRUCTIONS ***********
00050                    *
00051                    * CAUTION! THE READ/WRITE SWITCH SHOULD BE LEFT IN
00052                    * THE READ POSITION EXCEPT WHEN ACTUALLY PROGRAMMING
00053                    * AN EPROM. LEAVING IN WRITE WILL DISCHARGE BATTERIES.
00054                    *
00055                    * 1. LOAD STARTING RAM ADDRESS AT $A032-3.
00056                    *
00057                    * 2. LOAD LAST RAM ADDRESS AT $A034-5.
00058                    *
00059                    * 3. LOAD EPROM ADDRESS OFFSET AT $A036-7.
00060                    *
00061                    * 4. INSERT EPROM & TURN POWER SWITCH ON.
00062                    *
00063                    * 5. SET SWITCH TO WRITE FOR PROGRAMMING ONLY!
00064                    *
00065                    * 6. DOUBLE CHECK ADDRESSES BEFORE PROGRAMMING!
00066                    *
00067                    * 7. START DESIRED OPERATION.
00068                    *
00069                    * 8. THE JBUG PROMPT WILL RETURN WHEN FINISHED.
00070                    *    (PROGRAMMING TAKES 1.5 TO 2 MINUTES)
00071                    *
00072                    * 9. HIT RESET & SWITCH TO READ.
00073                    *
00074                    ************** ERROR MESSAGES ***************
00075                    *
00076                    * E0 = RAM ADDRESS RANGE GREATER THAN 1024.
00077                    *    (SELECTED FUNCTION NOT ATTEMPTED)
00078                    *
00079                    * E1 = RAM ADDRESS RANGE + EPROM ADDRESS
00080                    *    OFFSET GREATER THAN 1024.
00081                    *    (SELECTED FUNCTION NOT ATTEMPTED)
00082                    *
00083                    * E2 = EPROM ADDRESS OVERRANGE WHILE PROGRAMMING.
00084                    *  (SELECTED FUNCTION ABORTED WHEN OVERRANGE OCCURRED)
00085                    *
00086                    * E3 = EPROM AND RAM DID NOT AGREE DURING VERIFY.
00087                    *
00088                    * E4 = DESIGNATED EPROM LOCATIONS NOT ERASED.
00089                    *
00091                    *
00092                    ***************** EQUATES ********************
00093                    *
00094          8004  A PIADRA EQU    $8004    LSB OF EPROM ADDRESS
00095          8005  A PIACRA EQU    $8005    CA2 = EPROM ADDRESS LINE A8
00096          8006  A PIADRB EQU    $8006    DATA TO & FROM EPROM
00097          8007  A PIACRB EQU    $8007    CB2 = EPROM ADDRESS LINE A9
00098          8023  A PROG   EQU    $8023    CB2 = +27V PROGRAM PULSE CONTROL
00099          E08D  A JBUG   EQU    $E08D    JBUG REENTRY POINT
00100          E0FE  A OUTDS  EQU    $E0FE    JBUG DISPLAY ROUTINE
00101          A00C  A DISBUF EQU    $A00C    JBUG DISPLAY BUFFER
00102          A032  A STADR  EQU    $A032    START ADDRESS
00103          A034  A ENDADR EQU    $A034    END ADDRESS
00104          A036  A OFFSET EQU    $A036    EPROM ADDRESS OFFSET
00105          A038  A LOCCTR EQU    $A038    LOCATION COUNTER
00106          A03A  A LPCTR  EQU    $A03A    LOOP COUNTER
00107          A03B  A TEMPOS EQU    $A03B    TEMPORY STORAGE FOR OFFSET
00108                   *
00109                   ***************** JUMP TABLE *****************
00110                   *
00111A 0000 7E 000C  A         JMP    PROGM    PROGRAM MODE
00112A 0003 7E 0104  A         JMP    VERIFY   VERIFY MODE
00113A 0006 7E 0117  A         JMP    DNLOAD   DOWNLOAD MODE
00114A 0009 7E 0128  A         JMP    ERASED   ERASED? MODE
00115                   *
00116                   *
00117                   ************ PROGRAM ROUTINE ******************
00118                   *
00119                   *
00120A 000C BD 00E9  A PROGM   JSR    TEST     CHECK ADDRESS RANGES
00121A 000F 8D 38 0049         BSR    INIT     INITIALIZE PIA
00122A 0011 8E A078  A START   LDS    #$A078   RESTORE STACK POINTER
00123A 0014 F6 A036  A         LDAB   OFFSET   MSB EPROM ADDRESS
00124A 0017 F7 A03B  A         STAB   TEMPOS   SAVE IT
00125A 001A 8D 54 0070         BSR    FORMAT   FORMAT IT FOR PIA
00126A 001C B6 A037  A         LDAA   OFFSET+1 LSB EPROM ADDRESS
00127A 001F B7 8004  A         STAA   PIADRA
00128A 0022 CE 0400  A         LDX    #$400
00129A 0025 FF A038  A         STX    LOCCTR   SETS LOCATION COUNTER = 1024
00130A 0028 FE A032  A         LDX    STADR    POINT TO START ADDRESS
00131A 002B A6 00    A NEXT    LDAA   0,X      READ RAM BYTE
00132A 002D B7 8006  A         STAA   PIADRB   WRITE BYTE TO EPROM
00133A 0030 86 34    A         LDAA   #$34
00134A 0032 B7 8023  A         STAA   PROG     APPLY 27V PULSE, NMI DISABLED
00135A 0035 8D 71 00A8         BSR    DELAY    ONE MSEC DELAY
00136A 0037 86 3C    A         LDAA   #$3C
00137A 0039 B7 8023  A         STAA   PROG     REMOVE 27V PULSE, NMI DISABLED
00138A 003C BC A034  A         CPX    ENDADR   LAST ADDRESS?
00139A 003F 27 1D 005E         BEQ    TSTLOC   CHECK LOCATION COUNTER
00140A 0041 08                 INX             POINT TO NEXT ADDRESS
00141A 0042 8D 6A 00AE         BSR    INCROM   INC EPROM ADDRESS
00142A 0044 8D 00B9  A         JSR    DECLOC   DEC LOCATION COUNTER
00143A 0047 20 E2 002B         BRA    NEXT     GO DO NEXT ADDRESS
00144                   *
00146                   *
00147                   ******** PROGRAM MODE SUBROUTINES ********
00148                   *
00149A 0049 7F 8005  A INIT    CLR    PIACRA
00150A 004C 7F 8007  A         CLR    PIACRB
00151A 004F CE FF34  A         LDX    #$FF34
00152A 0052 FF 8004  A         STX    PIADRA   A SIDE OUTPUTS, CA2=0
00153A 0055 FF 8006  A         STX    PIADRB   B SIDE OUTPUTS, CB2=0
00154A 0058 86 64    A         LDAA   #$64
00155A 005A B7 A03A  A         STAA   LPCTR    SETS LOOP COUNTER = 100
```

```
00156A 005D 39                    RTS
00157                       *
00158                       *
00159A 005E 7D A038  A TSTLOC TST   LOCCTR   TEST LOCATION COUNTER (MSB)
00160A 0061 26 65 00C8      BNE   DEC
00161A 0063 7D A039  A      TST   LOCCTR+1  TEST LOCATION COUNTER (LSB)
00162A 0066 26 60 00C8      BNE   DEC
00163A 0068 7A A03A  A DECLP DEC   LPCTR    DEC LOOP COUNTER
00164A 006B 26 A4 0011      BNE   START     IF NOT LAST LOOP - START OVER
00165A 006D 7E E08D  A      JMP   JBUG      DONE - BACK TO JBUG
00166                       *
00167                       *
00168A 0070 F6 A038  A FORMAT LDAB  TEMPOS   GET EPROM ADDRESS (MSB)
00169A 0073 27 0B 0080      BEQ   SET0
00170A 0075 5A              DECB
00171A 0076 27 11 0089      BEQ   SET1
00172A 0078 5A              DECB
00173A 0079 27 19 0094      BEQ   SET2
00174A 007B 5A              DECB
00175A 007C 27 21 009F      BEQ   SET3
00176A 007E 20 5A 00DA      BRA   E2        IF EPROM MSB GREATER THAN 3
00177A 0080 C6 34    A SET0 LDAB  #$34      SETS EPROM MSB = 0
00178A 0082 F7 8005  A      STAB  PIACRA
00179A 0085 F7 8007  A      STAB  PIACRB
00180A 0088 39              RTS
00181A 0089 C6 3C    A SET1 LDAB  #$3C      SETS EPROM MSB = 1
00182A 008B F7 8005  A      STAB  PIACRA
00183A 008E C6 34    A      LDAB  #$34
00184A 0090 F7 8007  A      STAB  PIACRB
00185A 0093 39              RTS
00186A 0094 C6 34    A SET2 LDAB  #$34      SETS EPROM MSB = 2
00187A 0096 F7 8005  A      STAB  PIACRA
00188A 0099 C6 3C    A      LDAB  #$3C
00189A 009B F7 8007  A      STAB  PIACRB
00190A 009E 39              RTS
00191A 009F C6 3C    A SET3 LDAB  #$3C      SETS EPROM MSB = 3
00192A 00A1 F7 8005  A      STAB  PIACRA
00193A 00A4 F7 8007  A      STAB  PIACRB
00194A 00A7 39              RTS
00195                       *
00196                       *
00197A 00A8 86 66    A DELAY LDAA  #$66     SETS ONE MSEC DELAY
00198A 00AA 4A              DLY   DECA
00199A 00AB 26 FD 00AA      BNE   DLY
00200A 00AD 39              RTS
00201                       *
00203                       *
00204A 00AE 7C 8004  A INCROM INC   PIADRA   INC EPROM LSB
00205A 00B1 27 01 00B4      BEQ   INCMSB
00206A 00B3 39              RTS
00207A 00B4 7C A03B  A INCMSB INC   TEMPOS   INC EPROM MSB
00208A 00B7 20 B7 0070      BRA   FORMAT
00209                       *
00210                       *
00211A 00B9 7A A039  A DECLOC DEC   LOCCTR+1 DEC LOCATION COUNTER (LSB)
00212A 00BC 27 01 00BF      BEQ   DECMSB
00213A 00BE 39              RTS
00214A 00BF 7D A038  A DECMSB TST   LOCCTR
00215A 00C2 27 A4 0068      BEQ   DECLP
00216A 00C4 7A A038  A      DEC   LOCCTR    DEC LOCATION COUNTER (MSB)
00217A 00C7 39              RTS
00218                       *
00219                       *
00220A 00C8 8D EF 00B9 DEC  BSR   DECLOC
00221A 00CA 8D DC 00A8      BSR   DELAY     DUMMY DELAY IF < 1024 BYTES
00222A 00CC 20 90 005E      BRA   TSTLOC    LAST LOCATION DONE YET?
00223                       *
00224                       *
00225A 00CE 7F A011  A E0   CLR   DISBUF+5 SETS 6TH DIGIT OF DISBUF TO "0"
00226A 00D1 20 0E 00E1      BRA   ERROR
00227                       *
00228                       *
00229A 00D3 86 01    A E1   LDAA  #1
00230A 00D5 B7 A011  A      STAA  DISBUF+5 SETS 6TH DIGIT OF DISBUF TO "1"
00231A 00D8 20 07 00E1      BRA   ERROR
00232                       *
00233                       *
00234A 00DA 86 02    A E2   LDAA  #2
00235A 00DC B7 A011  A      STAA  DISBUF+5 SETS 6TH DIGIT OF DISBUF TO "2"
00236A 00DF 20 00 00E1      BRA   ERROR
00237                       *
00238                       *
00239A 00E1 86 0E    A ERROR LDAA  #$E
00240A 00E3 B7 A010  A      STAA  DISBUF+4 SETS 5TH DIGIT OF DISBUF TO "E"
00241A 00E6 7E E0FE  A      JMP   OUTDS     EXIT & DISPLAY ERROR MESSAGE
00242                       *
00243                       *
00244A 00E9 B6 A035  A TEST LDAA  ENDADR+1
00245A 00EC F6 A034  A      LDAB  ENDADR
00246A 00EF B0 A033  A      SUBA  STADR+1
00247A 00F2 F2 A032  A      SBCB  STADR
00248A 00F5 C1 04    A      CMPB  #4
00249A 00F7 24 D5 00CE      BCC   E0        OUT OF EPROM RANGE
00250A 00F9 BB A037  A      ADDA  OFFSET+1
00251A 00FC F9 A036  A      ADCB  OFFSET
00252A 00FF C1 04    A      CMPB  #4
00253A 0101 24 D0 00D3      BCC   E1        OUT OF EPROM RANGE
00254A 0103 39              RTS
00255                       *
00256                       *
00258                       *
00259                       *
00260                       ********** VERIFY ROUTINE **********
00261                       *
00262                       *
00263A 0104 8D 44 014A VERIFY BSR   SETUP
00264A 0106 A6 00    A VER  LDAA  0,X       READ RAM BYTE
00265A 0108 B1 8006  A      CMPA  PIADRB   COMPARE WITH EPROM BYTE
00266A 010B 26 2F 013C      BNE   E3        MEMORY & EPROM DON'T AGREE
00267A 010D BC A034  A      CPX   ENDADR    LAST ADDRESS?
00268A 0110 27 62 0174      BEQ   JBGJMP    RETURN TO JBUG
00269A 0112 08              INX             POINT TO NEXT ADDRESS
00270A 0113 8D 99 00AE      BSR   INCROM    INC EPROM ADDRESS
00271A 0115 20 EF 0106      BRA   VER       GO READ NEXT BYTE
00272                       *
00273                       *
00274                       ********** DOWNLOAD ROUTINE **********
00275                       *
00276                       *
```

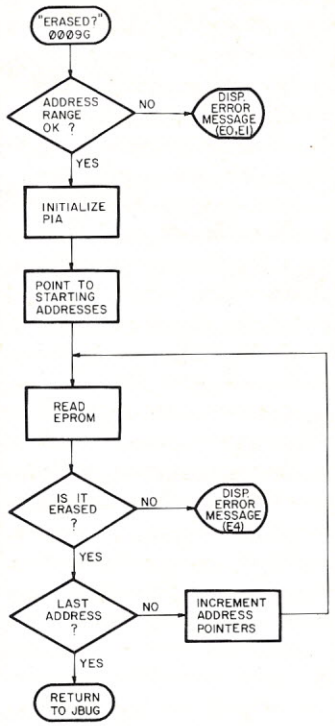


Fig. 5. ERASED? mode flowchart.

greater than 1024, and E1 means the last address minus the first address plus the EPROM address offset is greater than 1024.

If E2 appears on the display the EPROM address tried to exceed 1024 while the program was executing. You should hit reset, switch to READ, switch EPROM power off, reload the program and start over. If you were programming the EPROM when the E2 occurred it would probably have to be erased and reprogrammed.

If E3 or E4 appears you can find which EPROM location caused the error by reading the PIA registers. First push the ESCAPE (E) key, then 8004M. Record the contents of $8004 as the LSB (least significant byte) of the EPROM address. Now push the GO (G) key to read $8005. This register indicates the first bit of the MSB (most significant byte) of the EPROM address ($X4 = 0, $XC = 1).

Push the GO key again to read $8006. This is the data read from this location of the EPROM. Push the GO key again to read $8007. This indicates the second bit of the MSB of the EPROM address ($X4 = 0, $XC = 1). Use this bit with the one

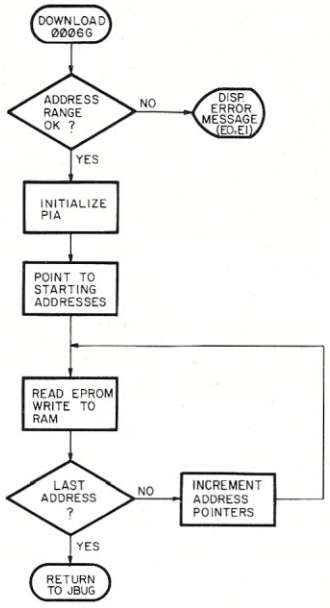


Fig. 6. DOWNLOAD mode flowchart.

```
00277A 0117 8D 31 014A DNLOAD BSR    SETUP
00278A 0119 B6 8006  A DNLD   LDAA   PIADRB   READ EPROM BYTE
00279A 011C A7 00    A        STAA   0,X      WRITE BYTE TO RAM
00280A 011E BC A034  A        CPX    ENDADR   LAST ADDRESS?
00281A 0121 27 51 0174        BEQ    JBGJMP   RETURN TO JBUG
00282A 0123 08                INX             POINT TO NEXT ADDRESS
00283A 0124 8D 88 00AE        BSR    INCROM   INC EPROM ADDRESS
00284A 0126 20 F1 0119        BRA    DNLD     GO DOWNLOAD NEXT BYTE
00285                  *
00286                  *
00287                  ********** ERASED? ROUTINE **********
00288                  *
00289                  *
00290A 0128 8D 20 014A ERASED BSR    SETUP
00291A 012A B6 8006  A ERAS   LDAA   PIADRB   READ EPROM BYTE
00292A 012D 81 FF    A        CMPA   #$FF     IS IT ERASED?
00293A 012F 26 12 0143        BNE    E4       EPROM NOT ERASED
00294A 0131 BC A034  A        CPX    ENDADR   LAST ADDRESS?
00295A 0134 27 3E 0174        BEQ    JBGJMP   RETURN TO JBUG
00296A 0136 08                INX             POINT TO NEXT ADDRESS
00297A 0137 8D 00AE  A        JSR    INCROM   INC EPROM ADDRESS
00298A 013A 20 EE 012A        BRA    ERAS     GO DO NEXT BYTE
00299                  *
00300                  *
00302                  *
00303                  ********** READ MODE SUBROUTINES **********
00304                  *
00305A 013C 86 03    A E3     LDAA   #3
00306A 013E B7 A011  A        STAA   DISBUF+5 SETS 6TH DIGIT OF DISBUF TO "3"
00307A 0141 20 9E 00E1        BRA    ERROR
00308                  *
00309                  *
00310A 0143 86 04    A E4     LDAA   #4
00311A 0145 B7 A011  A        STAA   DISBUF+5 SETS 6TH DIGIT OF DISBUF TO "4"
00312A 0148 20 97 00E1        BRA    ERROR
00313                  *
00314                  *
00315A 014A 8D 9D 00E9 SETUP  BSR    TEST     CHECK ADDRESS RANGES
00316A 014C 8D 13 0161        BSR    INIT1    INITIALIZE PIA
00317A 014E F6 A036  A        LDAB   OFFSET   MSB EPROM ADDRESS
00318A 0151 F7 A03B  A        STAB   TEMPOS   SAVE IT
00319A 0154 BD 0070  A        JSR    FORMAT   FORMAT IT FOR PIA
00320A 0157 B6 A037  A        LDAA   OFFSET+1 LSB EPROM ADDRESS
00321A 015A B7 8004  A        STAA   PIADRA
00322A 015D FE A032  A        LDX    STADR    POINT TO START ADDRESS
00323A 0160 39                RTS
00324                  *
00325                  *
00326A 0161 7F 8005  A INIT1  CLR    PIACRA
00327A 0164 7F 8007  A        CLR    PIACRB
00328A 0167 CE FF34  A        LDX    #$FF34
00329A 016A FF 8004  A        STX    PIADRA   A SIDE OUTPUTS, CA2=0
00330A 016D CE 0034  A        LDX    #$0034
00331A 0170 FF 8006  A        STX    PIADRB   B SIDE INPUTS, CB2=0
00332A 0173 39                RTS
00333                  *
00334                  *
00335A 0174 7E E08D  A JBGJMP JMP    JBUG     OPERATION DONE, RETURN TO JBUG
00336                  *
00337                  *
00338                         END
TOTAL ERRORS 00000


DEC    00C8  DECLOC 00B9  DECLP  0068  DECMSB 00BF  DELAY  00A8  DISBUF A00C
DLY    00AA  DNLD   0119  DNLOAD 0117  E0     00CE  E1     00D3  E2     00DA
E3     013C  E4     0143  ENDADR A034  ERAS   012A  ERASED 0128  ERROR  00E1
FORMAT 0070  INCMSB 00B4  INCROM 00AE  INIT   0049  INIT1  0161  JBGJMP 0174
JBUG   E08D  LOCCTR A038  LPCTR  A03A  NEXT   002B  OFFSET A036  OUTDS  E0FE
PIACRA 8005  PIACRB 8007  PIADRA 8004  PIADRB 8006  PROG   8023  PROGM  000C
SET0   0080  SET1   0089  SET2   0094  SET3   009F  SETUP  014A  STADR  A032
START  0011  TEMPOS A03B  TEST   00E9  TSTLOC 005E  VER    0106  VERIFY 0104
```

from $8005 to decode the MSB of the EPROM address. If both bits are 0 then the MSB = $00; if the first bit is 1 and the second is 0 then the MSB = 1; if the first bit is 0 and the second is 1 then the MSB = $02; and if both bits are 1 then the MSB = $03.

If the error is E4 you now know which location is not erased and the contents of that location (an erased location reads $FF), but about all you can do is to try erasing the EPROM again. If the error is E3 you can also read the corresponding RAM location to determine the difference between the EPROM and the RAM. If the difference is a bit in the EPROM that is a 1 and should be a 0, try programming it again. If it is a bit that is a 0 and should be a 1, the EPROM will have to be erased before programming.

If E3 errors continue to occur check your batteries for at least 8.5 volts each with a 20 mA load. Because the program stops execution when an error occurs, only the first error can be located in either case.

Don't let all these error messages scare you. With careful planning and keypunching you may never see one.

Final Thoughts

A few notes about what types of programs to put in EPROM and how to modify them if necessary to get you started: First, this program itself is an ideal candidate if you have limited RAM available because it will leave your entire RAM area free for the program that you are putting in EPROM. Other likely candidates to consider are: memory tests (so you can test all of your RAM), subroutines that you use frequently (saves RAM every time they are called), added functions that your monitor ROM doesn't perform and any other programs that you want ready to run immediately when your system is powered up.

Before putting a program in EPROM, you must first make sure it has no self-modifying code and that all jumps to absolute addresses within the program are changed to match what the addresses will be when the EPROM is plugged into its normal socket. No self-modifying code means all variables must be located in RAM somewhere else. In the D2 kit you can use the scratchpad RAM ($A000-$A07F) used by the monitor if you don't interfere with the monitor's variables. Generally $A032-$A05F can be used safely as is the case with this program, which uses $A032-$A03B.

There are eight jumps to absolute addresses within the program used with the 2708 EPROM programmer. Four of these are in the jump table at the beginning of the program. The others are located at lines 120, 142, 297 and 319. All of these must be changed to put this program in EPROM or to relocate anywhere else in RAM.

The 2708 EPROM programmer circuit was held to the minimum to keep the cost down. If you didn't mind spending a little more, it could be built into a separate box and connected to the D2 kit through connector J1. The +27 V could be supplied from a separate power supply if available. LEDs could be added to indicate when power was on and when the read/write switch was in the write position (see Fig. 1). If you anticipate heavy use, a more expensive zero-insertion-force type socket should be used for the EPROM. ■

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Dresher PA 19025

Stretching the Outer Limits

Your TRS-80 is a wonderful machine, but sooner or later you will realize that it has its limits. At times, the realization is transitory, and at times it is puzzling or downright annoying. You either say, "That's life" or you try to puzzle a way out of the problem of the moment. One such encounter led my son, Jay, and I to come up with a solution to a problem that may seem either trival or otherwise, depending on your own set of mind.

To set the scene, key in this little program:

```
10 INPUT A
20 INPUT B
30 C = A – B
40 PRINT C
```

It's just a simple subtraction routine, hardly spectacular, until you probe its apparent limits. For A, input a string of 25 nines. For B, input a string of 10 eights. Then run the program. The answer you get is 1E + 25, which is unsatisfactory if you are doing an occasional calculation that involves large integer numbers and in which you wish to retain accuracy down to the last digit.

Try another example. For A, input the same 25 nines. For B, input 1. Now run the program. The answer you get is 1E + 25, the same answer you got before. This is merely to show the apparent size of the limitation we are talking about.

In the first example, if you pushed a graphite character generator across a sheet of papyrus, you would have gotten an answer of 999999999999-9991111111111, and in the second example you would have gotten an answer of 999999999-9999999999999998. If you are tempted to use the DEFDBL command, then you can get better answers than 1E25, *but* you cannot equal the answer you got with pencil and paper.

The Program

There is a way to program yourself out of the problem, and Jay came up with the accompanying program listing, which I subsequently modified after an unexpected bug turned up. The program is fairly direct, but a few comments may be in order.

First, it is limited to integers, albeit large integers. No decimal points please! The largest number *must* be inserted first. Then the smaller number to be subtracted is entered. If you are curious, you may invert this order when trying out the program, and if you are darned good at interpreting a form of nine's complement math, you may make sense out of the answer.

A null symbol appears in lines 260 and 320. This consists of a pair of quotation marks with *no* intervening space. Certain lines of the program from line 280 contain the variable SIZE, which in its entirety takes care of the problem that would exist without this routine, that is, the necessity of inserting leading zeros into the smaller number so that the actual total number of numerical positions occupied by A and B is identical.

This problem is generated by the use of aligned arrays to implement the subtraction process. Certainly there is another way to handle the problem, but that will have to wait for another day. Line 200 rejects your efforts to inject a decimal point or other nonnumeric character into the numbers, either by accident or curiosity.

We can adapt a somewhat similar routine to the addition of large integers, but for right now, pleasant weather and the discovery that the garden needs lots of work have uncovered another limit of the TRS-80: it's not worth a shucks when it comes to weeding! How about coming up with a program for that? You will have at least one paying customer for the software. ■

```
5 REM PGM BY JAY JOFFE, MODIFIED BY W3KBM
10 CLS
15 CLEAR
20 CLEAR 2000:REM SUBTRACTION OF LARGE INTEGERS
30 DIM A(100)
40 DIM B(100)
50 DIM N$(100)
60 DIM T(100)
70 PRINT:PRINT
80 PRINT"THIS IS AN INTEGER PROGRAM...NO DECIMAL POINTS PLEASE"
85 PRINT
90 PRINT "SUBTRACTION PROGRAM--ENTER LARGEST NUMBER FIRST":        GOTO 100
100 GOSUB 260
110 GOSUB 320
120 PRINT "A-B=";
130 PRINT"----------"
140 GOSUB 410
150 GOSUB 480
160 FOR W=2 TO 100: A(W)=0:B(W)=0:NEXT
170 GOTO 90
180 FORX= (101-LEN(N$)) TO 100
190 T(X)= ASC(MID$(N$,Y,1))-48
200 IF T(X)>9 OR T(X)<0 THEN GOTO 230
210 Y=Y+1
220 NEXT X: GOTO 250
230 PRINT "NON NUMERIC DATA"
240 FORX=1TO440:NEXT: GOTO 15
250 RETURN
260 Y=1:N$=""
270 INPUT "A=";N$
280 SIZE =LEN(N$)
290 GOSUB 180
300 GOSUB 640
310 RETURN
320 Y=1:N$=""
330 INPUT "B=";N$
340 SIZE=SIZE-LEN(N$)
350 FOR J= 1 TO SIZE
360 J$=J$+"0":NEXT J
370 N$=J$+N$
380 GOSUB 180
390 GOSUB 630
400 RETURN
410 FOR X = 100 TO 2 STEP -1
420  A(X)=A(X)-B(X)
430  IF A(X)>=0 THEN 460
440 A(X)=A(X)+10
450 A(X-1)=A(X-1)-1
460 NEXT X
470 RETURN
480 GOSUB 650
490 GOSUB 580
500 N$=""
510 FOR X = T(1) TO 100
520 N$=N$+CHR$(A(X)+48)
530 NEXT X
560 IF N$<"1" PRINT "ANSWER IS ZERO" ELSE PRINT N$
570 GOTO 15
580 FOR X = 2 TO 100
590 IF T(X)=0 THEN 610
600 T(1)=X: GOTO 620
610 NEXT X
620 RETURN
630 FOR X = 1 TO 100: B(X)=T(X):NEXT :RETURN
640 FOR X = 1 TO 100: A(X)=T(X):NEXT :RETURN
650 FOR X = 1 TO 100: T(X)=A(X):NEXT :RETURN
660 END
```

Program listing.

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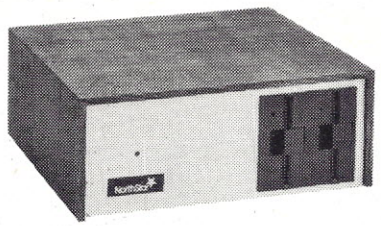
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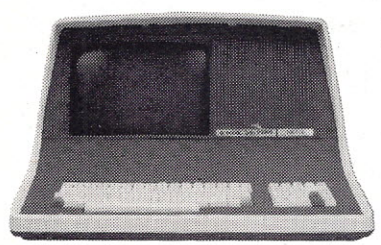
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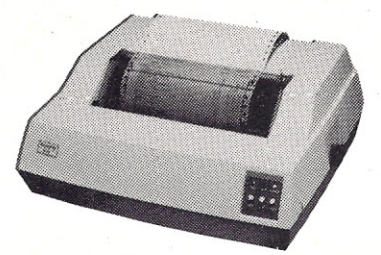


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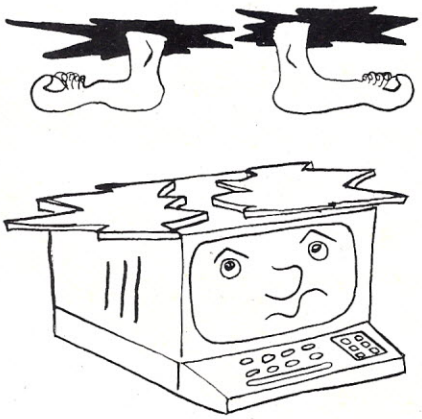
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Connect the ADM-3A to the SWTP 6800

A concise explanation of how to do it.

Joseph J. O'Loughlin III
908 Salem Dr.
Huron OH 44839

My recently acquired ADM-3A was patiently waiting for correct cable connections along with the proper function switch selection scheme. I wasted a maddening amount of time experimenting and trying to find information that would provide the clues, after my initial attempts failed.

I uncovered several articles that discussed the use of the ADM-3A with the SWTP M6800 but found not a hint of exactly how they were connected. This article offers the needed information accompanied only by short comments rather than a study of the reasons why it works.

The working configuration assumes the ADM-3A will be attached directly to an MP-C on port #1 in the SWTP M6800 with the MP-C jumpered for 300 baud.

The ability to make the MP-C and the ADM-3A run at higher baud rates is the subject of a May 1977 *Kilobaud* article ("Make Your Investment Count," p. 38). Incorporating that article's ideas will still require the cable connections detailed in this article.

Upper Set

BIT 8-0	
	INH
STOP 1	
	8
PARITY-ODD	
	UC

Lower Set

AUTO NL	
RS232	
HDX	
300	

Fig. 1a. DIP switches located under LSI nameplate next to keyboard.

Left Set **Right Set**

	ADV	CUR CTL
UC DISP		LOCAL
	KB LOCK	OFF
	CLR SCRN	OFF
	60 HZ	SEC
	24 LINE	OFF
		OFF

Fig. 1b. DIP switches located inside ADM-3A case at center rear of printed circuit board.

Construction

The easiest part of the problem is a matter of properly setting the DIP function selection switches in the ADM-3A. Fig. 1 shows the required settings.

The cable is not particularly difficult to construct but is prone to faulty construction because of the special connector needed for the ADM-3A. To properly terminate the cable at the ADM-3A end, you should use a male DB-25 plug and protective hood to connect with the female DB-25 already installed on the ADM-3A. The necessary plug and hood are available through *Microcomputing* advertisers.

To properly orient the DB-25 while making the connections shown in Fig. 2, carefully study the view of the plug shown from the cable connection side of the plug where the connections will be soldered. If you carefully inspect the DB-25 plug, you will be able to see the same numbers molded into the plastic next to each pin connection.

After making the connections shown in Fig. 2, carefully inspect the DB-25 plug and the MP-C molex connector plug for wiring errors. If no errors are present, plug the male DB-25 plug into the ADM-3A female DB-25 labeled MODEM at the rear of your ADM-3A.

If your ADM-3A doesn't respond properly, you have made a wiring error, with the most likely candidate being the DB-25 end of the cable. It is easy to make mistakes because of the close spacing, number of pins on the connector and/or improper orientation of the plug during construction. ■

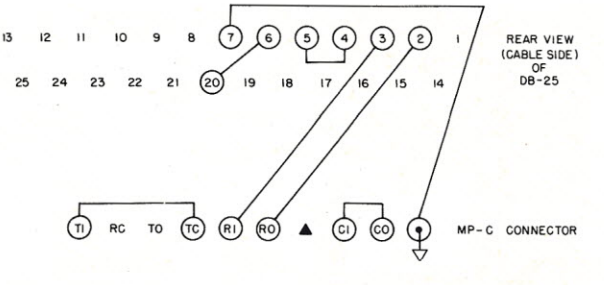
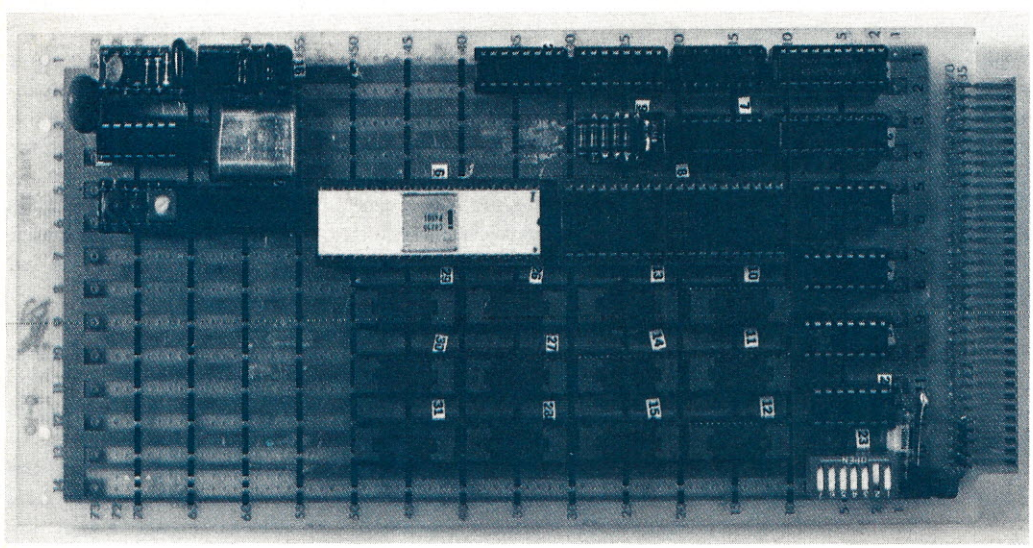


Fig. 2. Jumpers 4 to 5 and 6 to 20 are installed to fool the ADM-3A into thinking it is working with a telephone modem. Without these jumpers installed, the ADM-3A will not function.

Color TV Display: Use Those New LSI Chips

Color is the wave of the future. The future is now with these chips.

John C. Mein
American Microsystems, Inc.
8255 Jellison Ct.
Arvada CO 80005



Video display generator.

Several integrated circuit (IC) houses are now manufacturing a large-scale integrated (LSI) video display generator (VDG) designed to produce composite video suitable for display on a standard black and white or color TV monitor. This IC significantly reduces the cost and complexity of a video display interface for your computer. I chose to design a system around the American Microsystems, Inc. (AMI), S68047 VDG because of its interface simplicity, versatility and low cost (about $15). This VDG will work with any microprocessor.

Described here is a circuit I built for my home-brew 8080 that uses the AMI S68047 VDG with a few supporting ICs. It can be constructed for only about $50 (excluding memory cost).

Listing 1. Video driver software.

```
                ********************************************************************************
                *                                                                              *
                *           VIDEO DRIVER SOFTWARE                                              *
                *                                                                              *
                ********************************************************************************
1400 A  LOC     EQU     X'1400'         STARTING ADDRESS FOR ASSEMBLY
0400 A  VIDH    EQU     X'400'              STARTING ADDRESS OF VIDEO RAM
0004 A  VID     EQU     X'4'            HIGH-ORDER STARTING ADDRESS OF VIDEO RAM
0024 A  WAIT    EQU     X'24'           THIS IS THE DELAY FOR BAUD RATE SYNTHESIS
0025 A  VDPTR   EQU     X'25'           CURSOR POINTER RAM LOCATION
0027 A  VDHLD   EQU     X'27'           CHARACTER HOLD IN RAM
                ********************************************************************************
                *                                                                              *
                *           NON-DISPLAYABLE CHARACTERS                                         *
                *                                                                              *
                ********************************************************************************
000C A  FF      EQU     X'C'            FORM FEED, CONTROL-L
```

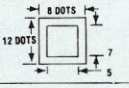
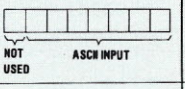
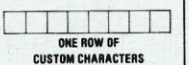
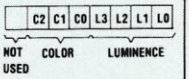
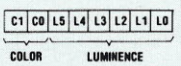
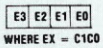
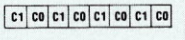
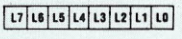
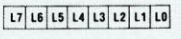
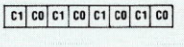
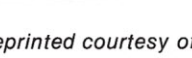
VDG PINS								COLOR			TV SCREEN		VDG DATA BUS	COMMENTS
A/G	A/S	INT/EXT	GM4	GM2	GM1	CSS	INV	CHARACTER COLOR	BACK-GROUND	BORDER	DISPLAY MODE	DETAIL		
0	0	0	X	0	0	0	0	Green	Black	Black	32 Characters in columns 16 Characters in rows			ALPHANUMERIC INTERNAL mode uses internal character generator with on-chip 64 ASCII character ROM to display each character in 5x7 dot matrix font.
							1	Black	Green					
						1	0	Blue	Black	Black				
							1	Black	Blue					
0	0	1	X	0	0	0	0	Green	Black	Black	32 Characters in columns 16 Characters in rows			ALPHANUMERIC EXTERNAL mode uses external ROM or RAM to display 512 characters in custom fonts each in 8x12 dot matrix.
							1	Black	Green					
						1	0	Green	Black	Black				
							1	Black	Green					
0	1	0	X	0	0	X	X	L_X C_2 C_1 C_0 Color 0 X X X Black 1 0 0 0 Green 1 0 0 1 Yellow 1 0 1 0 Cyan 1 0 1 1 Red 1 1 0 0 Blue 1 1 0 1 Cyan/ Blue 1 1 1 0 Magenta 1 1 1 1 Orange		Black	64 Display elements in columns 32 Display elements in rows			SEMIGRAPHICS 4 mode subdivides each of the 512 (32x16) character blocks of 8x12 dots into four equal parts. The dominance of each block is determined by the corresponding bit (L0-L3) on the VDG data bus. Color of each block is determined by 3 bits (C0-C2).
0	1	1	X	0	0	0	X	L_X C_1 C_0 0 0 0 Black 1 0 0 Green 1 0 1 Yellow 1 1 0 Cyan 1 1 1 Red 1 0 0 Blue 1 0 1 Cyan/ Blue 1 1 0 Magenta 1 1 1 Orange		Black	64 Display elements in columns 48 Display elements in rows			SEMIGRAPHICS 6 mode subdivides each of the 512 (32x16) character blocks of 8x12 dots into six equal parts. The luminance of each part is determined by the corresponding bits (L0-L5) on the VDG bus. Color of each block is determined by 2 bits (C0, C1).
1	X	X	0	0	0	0	X	C_1 C_0 0 0 Green 0 1 Yellow 1 0 Cyan 1 1 Red 0 0 Blue 0 1 Cyan/ Blue 1 0 Magenta 1 1 Orange		Green Cyan/ Blue	64 Display elements in columns 64 Display elements in rows			GRAPHICS 0 mode uses a maximum of 1024 bytes of display RAM in which one pair of bits (C0, C1) specifies on picture element. (Ex.).
1	X	X	0	0	1	0	X	L_X 0 Color Black 1 Green		Green	128 Display elements in columns 64 Display elements in rows			GRAPHICS 1 mode uses a maximum of 1024 bytes of display RAM in which one bit (Lx) specifies one picture element.
						1		0 Black 1 Cyan/ Blue		Cyan/ Blue				
1	X	X	1	0	0	0	X	Same color as Graphics 0		Green	128 Display elements in columns 64 Display elements in rows			GRAPHICS 2 mode uses a maximum of 2048 bytes of display RAM in which one pair of bits (C0, C1) specifies one picture element (Ex.).
						1				Cyan/ Blue				
1	X	X	0	1	1	0	X	Same color as Graphics 1		Green	128 Display elements in columns 96 Display elements in rows			GRAPHICS 3 mode uses a maximum of 1536 bytes of display RAM in which one bit (Lx) specifies one picture element.
						1				Cyan/ Blue				
1	X	X	0	1	0	0	X	Same color as Graphics 0		Green	128 Display elements in columns 96 Display elements in rows			GRAPHICS 4 mode uses a maximum of 3072 bytes of display RAM in which one pair of bits (C0, C1 specifies one picture element (Ex.)
						1				Cyan/ Blue				
1	X	X	1	0	1	0	X	Same color as Graphics 1		Green	256 Display elements in columns 96 Display elements in rows			GRAPHICS 5 mode uses a maximum of 3072 bytes of display RAM in which one bit (Lx) specifies one picture element.
						1				Cyan/ Blue				
1	X	X	1	1	0	0	X	Same color as Graphics 0		Green	128 Display elements in columns 192 Display elements in rows			GRAPHICS 6 mode uses a maximum of 6144 bytes of display RAM in which one pair of bits (C0, C1) specifies one picture element (Ex.).
						1				Cyan/ Blue				
1	X	X	1	1	1	0	X	Same color as Graphics 1		Green	256 Display elements in columns 192 Display elements in rows			GRAPHICS 7 mode uses a maximum of 6144 bytes of display RAM in which one bit (Lx) specifies one picture element.
						1				Cyan/ Blue				

Table 1. Detailed description of VDG model (reprinted courtesy of American Microsystems, Inc.).

The device allows you to display alphanumerics or graphics in full color on your home TV.

When attached to your TV monitor, this circuit, shown in Fig. 1, displays the contents of a block of memory shared with your microprocessor. The memory has a capacity of 4K × 12 bits. The circuit can be operated in three modes: alphanumerics, semigraphics or full graphics. The first two modes can be intermixed on the screen, whereas switching between full graphics and the other modes can occur only on a line-by-line basis. The modes are detailed in Table 1.

The alphanumeric mode enables the VDG to display a matrix of 32 characters × 16 lines. The internal mode utilizes an on-chip, 64 ASCII-character ROM to display each character in a 5 × 7 dot matrix front.

The two semigraphic modes, SG4 and SG6, subdivide each of the 512 (32 × 16) character

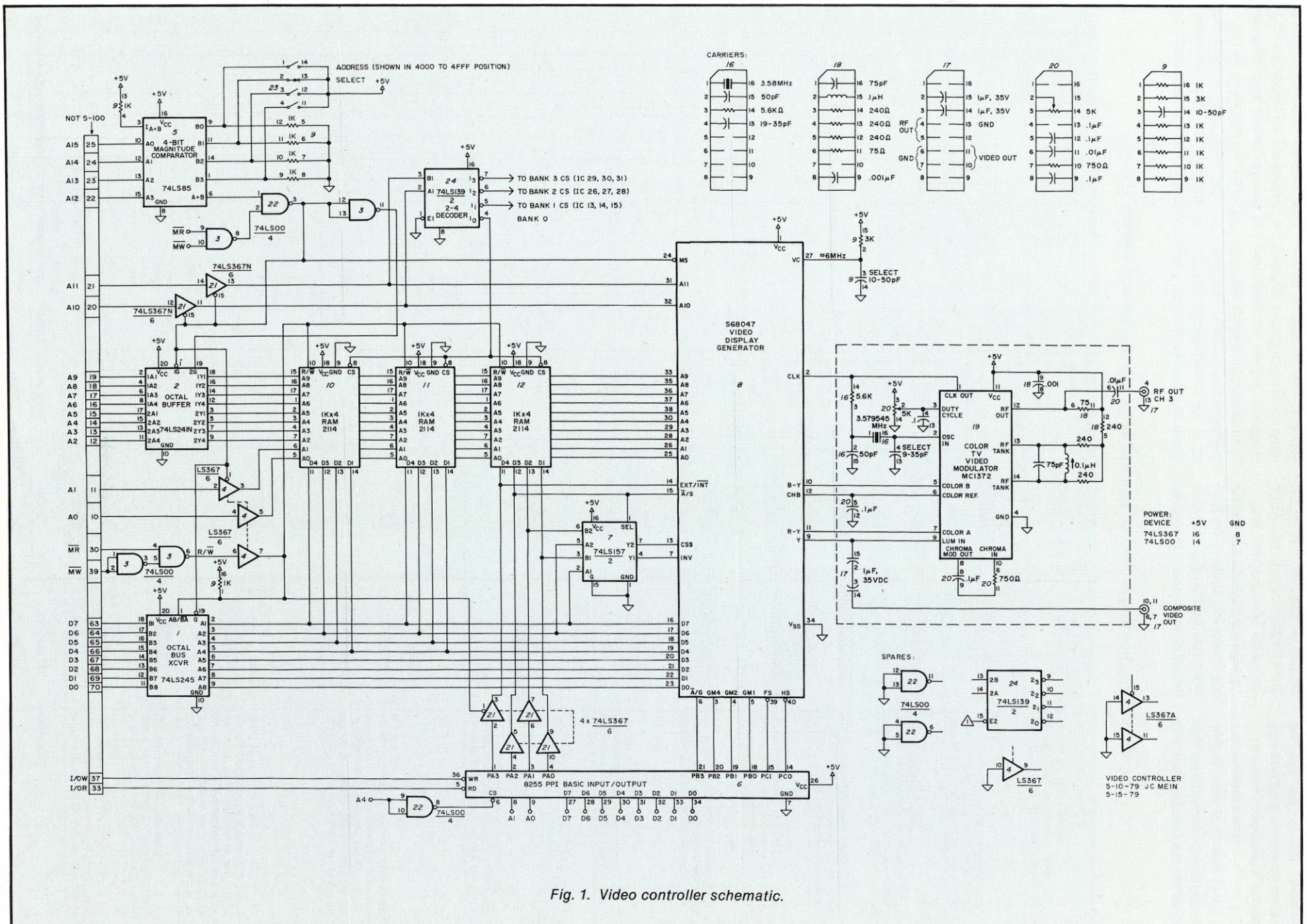


Fig. 1. Video controller schematic.

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013

See next "Small Systems Journal" in the March issue.

```
                0004 A  LF      EQU     4               LINE FEED
                0009 A  CTRLI   EQU     9               CONTROL I, INVERT THE CHARACTER
                000D A  CR      EQU     X'D'            CARRIAGE RETURN
                        ********************************************************************************
                        *                                                                              *
                        *          CURSOR CONTROL CHARACTERS                                           *
                        *                                                                              *
                        ********************************************************************************
                0015 A  UP      EQU     X'15'           CONTROL-U, UP
                000A A  DN      EQU     X'A'            CONTROL-D, DOWN
                0006 A  FW      EQU     6               CONTROL-F, FORWARD
                0008 A  BS      EQU     8               BACKSPACE
                000B A  HM      EQU     X'B'            CONTROL-K, RETURN CURSOR TO HOME

                        SPACE   2
                        ********************************************************************************
                        *                                                                              *
                        *          SET UP 8080A REGISTERS                                              *
                        *                                                                              *
                        ********************************************************************************

                        SPACE   2
                        ********************************************************************************
                        *                                                                              *
                        *          NORMAL ENTRY POINT                                                  *
                        *                                                                              *
                        ********************************************************************************
1400                    ORG     L0C
1400    00E5 A  VDTTY   PUSH    H               SAVE H,L REGISTERS
1401    0021 A          LXI     H,VDPTR         ADDRESS OF CURSOR POINTER
1402    0025 A
1403    0000 A
1404    00D5 A  ALTVDI: PUSH    D               SAVE DE
1405    00C5 A          PUSH    B               SAVE BC
1406    00F5 A          PUSH    PSW             SAVE AF
1407    003E A          MVI     A,X'89'         CONTROL WORD FOR PPI SET-UP
1408    0089 A
1409    00D3 A          OUT     X'13'           OUTPUT CONTROL WORD TO PPI
140A    0013 A
140B    003E A          MVI     A,0             SET UP FOR ALPHANUMERICS
140C    0000 A
140D    00D3 A          OUT     X'11'
140E    0011 A
140F    005E A          MOV     E,M             LPTR
1410    0023 A          INX     H
1411    007E A          MOV     A,M             HPTR
1412    00E6 A          ANI     3               CONVERT TO VIDEO
1413    0003 A
1414    00C6 A          ADI     VID             RAM ADDRESS
1415    0004 A
1416    0057 A          MOV     D,A
1417    0023 A          INX     H
1418    007E A          MOV     A,M             CHAR IN HOLD UNDER CURSOR
1419    00EB A          XCHG                    PNTR TO HL
141A    00CD A          CALL    DELAY           WAIT THE SET NUMBER OF MILLISECONDS
141B    000E A
141C    0015 A
141D    00CD A          CALL    CURSOR          RESTORE PREVIOUS CHARACTER
141E    0028 A
141F    0015 A
                        ********************************************************************************
                        *                                                                              *
                        *          IDENTIFY THE INPUT CHARACTER                                        *
                        *                                                                              *
                        ********************************************************************************
1420    0079 A          MOV     A,C             GET NEW CHARACTER
1421    00E6 A          ANI     X'7F'
1422    007F A
1423    004F A          MOV     C,A
1424    00FE A          CPI     FF
1425    000C A
1426    00CA A          JZ      VIDFF           IT WAS A FORM FEED
1427    0081 A
1428    0014 A
1429    00FE A          CPI     CR
142A    000D A
142B    00CA A          JZ      VIDCR           IT WAS A CARRIAGE RETURN!
142C    0092 A
142D    0014 A
142E    00FE A          CPI     CTRLI
142F    0009 A
1430    00CA A          JZ      INVERT          IT WAS A INVERT VIDEO
1431    00FA A
1432    0014 A
                *                               THE FOLLOWING INSTRUCTIONS
                *                               (MARKED YYYY MAY BE REMOVED
                *                               IF CURSOR CONTROL IS NOT REQUIRED
1433    00FE A          CPI     UP              YYYY
1434    0015 A
1435    00CA A          JZ      CRUP            YYYY
1436    00E2 A
1437    0014 A
1438    00FE A          CPI     DN              YYYY
1439    000A A
143A    00CA A          JZ      CRDN            YYYY
143B    00E8 A
143C    0014 A
143D    00FE A          CPI     FW              YYYY
143E    0006 A
143F    00CA A          JZ      CRRT            YYYY
1440    0050 A
1441    0014 A
1442    00FE A          CPI     BS              YYYY
1443    0008 A
1444    00CA A          JZ      CRLT            YYYY
1445    00EE A
1446    0014 A
1447    00FE A          CPI     HM              YYYY
1448    000B A
1449    00CA A          JZ      CRHM            YYYY
144A    00F4 A
144B    0014 A
                        ********************************************************************************
                        *                                                                              *
                        *          DISPLAYABLE CHARACTER                                               *
                        *                                                                              *
                        ********************************************************************************
144C    00CD A  VIDBO   CALL    DELAY           WAIT THE SET NUMBER OF MILLISECONDS
```

blocks of 8 × 12 dots each into smaller blocks of 2 × 2 and 2 × 3, respectively. In SG4 each block is created from 4 × 6 dots and can be displayed in eight colors plus black. In SG6 each block consists of 4 × 4 dots and can be displayed in four colors plus black.

The VDG can also operate in one of eight full-graphics modes. These can be divided into two major groups, four color and two color. The four color graphics modes provide four display densities, ranging from 64 × 64 elements (for graphics 0) to 128 × 192 elements (for graphics 6). The two color graphics modes also provide four display densities, ranging from 128 × 64 elements (for graphics 1) through the highest density of 256 × 192 elements (in graphics 7).

Theory

A video display generator reads digital data from a random-access display memory, which is controlled by a microprocessor (sometimes called a refresh memory), and converts it into analog video waveforms that contain brightness and color information. The waveforms are synchronized with the TV raster by adding timing pulses. These signals can be fed directly into a black and white monitor or a chroma modulator, which encodes them into a composite rf signal that replicates a TV transmission on Channel 3 or 4.

The ease of changing the display contents makes this memory-mapped scheme of CRT control very attractive. To change a display element you simply store the desired character or graphics information into the appropriate RAM location that corresponds to a particular location on the TV screen.

The circuit does not slow down the microprocessor to refresh the screen as some CRT controllers do. During normal computations the VDG automatically refreshes the screen by addressing the video memory without interrupting the microprocessor address or data buses. To change the information on the screen, the microprocessor normally reads the VDG field

TRS-80 MODEL II FORMAT NOW AVAILABLE

DIGITAL RESEARCH

Software with Manual / Manual Alone

☐ **CP/M* FLOPPY DISKETTE OPERATING SYSTEM** — Packages supplied on diskette complete with 8080 assembler, text editor, 8080 debugger and various utilities plus full documentation. CP/M available configured for most popular computer/disk systems including: North Star Single, Double or Quad density, Altair 8" disks, Helios II, Exidy Sorcerer, Vector MZ, Heath H17† or H89†, TRS-80†, iCOM 3712 and iCOM Micro Disk plus many other configurations available off the shelf. **$145/$25**
CP/M version 2 (not all formats available immediately) **$170/$25**

☐ **MP/M*** **$300/$50**

Lower prices!

☐ **MAC** — 8080 Macro Assembler. Full Intel macro definitions. Pseudo Ops include RPC, IRP, REPT, TITLE, PAGE, and MACLIB. Z-80 library included. Produces Intel absolute hex output plus symbols file for use by SID (see below) **$85/$15**

☐ **SID** — 8080 symbolic debugger. Full trace, pass count and break-point program testing system with back-trace and histogram utilities. When used with MAC, provides full symbolic display of memory labels and equated values **$70/$15**

NEW! → ☐ **ZSID**–As above for Z-80. Requires Z-80 CPU **$95/$15**

☐ **TEX** — Text formatter to create paginated, page-numbered and justified copy from source text files, directable to disk or printer **$70/$15**

☐ **DESPOOL** — Program to permit simultaneous printing of data from disk while user executes another program from the console **$45/$5**

All Microsoft prices are discounted!

MICROSOFT

☐ Ⓛ Ⓜ **BASIC-80** — Disk Extended BASIC, ANSI compatible with long variable names, WHILE/WEND, chaining, variable length file records **$300/$25**

☐ Ⓛ Ⓜ **BASIC COMPILER** — Language compatible with BASIC-80 and 3-10 times faster execution. Produces standard Microsoft relocatable binary output. Includes Macro-80. Also linkable to FORTRAN-80 or COBOL-80 code modules **$350/$25**

☐ Ⓛ Ⓜ **FORTRAN-80** — ANSI '66 (except for COMPLEX) plus many extensions. Includes relocatable object compiler, linking loader, library with manager. Also includes MACRO-80 (see below) **$400/$25**

☐ Ⓛ Ⓜ **COBOL-80** — ANSI '74 Relocatable object output. Format same as FORTRAN-80 and MACRO-80 modules. Complete ISAM, interactive ACCEPT/DISPLAY, COPY, EXTEND **$625/$25**

☐ Ⓛ Ⓜ **MACRO-80** — 8080/Z80 Macro Assembler. Intel and Zilog mnemonics supported. Relocatable linkable output. Loader, Library Manager and Cross Reference List utilities included **$149/$15**

☐ Ⓛ **XMACRO86** — 8086 cross assembler. All Macro and utility features of MACRO-80 package. Mnemonics slightly modified from Intel ASM86. Compatibility data sheet available. **$275/$25**

☐ Ⓛ **EDIT-80** — Very fast random access text editor for text with or without line numbers. Global and intra-line commands supported. File compare utility included **$89/$15**

MICRO FOCUS

☐ Ⓛ **STANDARD CIS COBOL** — ANSI '74 COBOL standard compiler fully validated by U.S. Navy tests to ANSI level 1. Supports many features to level 2 including dynamic loading of COBOL modules and a full ISAM file facility. Also, program segmentation, interactive debug and powerful interactive extensions to support protected and unprotected CRT screen formatting from COBOL programs used with any dumb terminal **$850/$50**

☐ Ⓛ **FORMS 2** — CRT screen editor. Output is COBOL data descriptions for copying into CIS COBOL programs. Automatically creates a query and update program of indexed files using CRT protected and unprotected screen formats. No programming experience needed. Output program directly compiled by CIS COBOL (standard) **$200/$20**

EIDOS SYSTEMS

☐ Ⓛ **KISS** — Keyed Index Sequential Search. Offers complete Multi-Keyed Index Sequential and Direct Access file management. Includes built-in utility functions for 16 or 32 bit arithmetic, string/integer conversion and string compare. Delivered as a relocatable linkable module in Microsoft format for use with FORTRAN-80 or COBOL-80, etc. **$335/$23**

☐ Ⓛ **KBASIC** — Microsoft Disk Extended BASIC with all KISS facilities, integrated by implementation of nine additional commands in language. Package includes KISS.REL as described above, and a sample mail list program **$585/$45**
to licensed users of Microsoft BASIC-80 (MBASIC) **$435/$45**

All Micropro prices are discounted!

MICROPRO

Software with Manual / Manual Alone

☐ Ⓛ **SUPER-SORT I** — Sort, merge, extract utility as absolute executable program or linkable module in Microsoft format. Sorts fixed or variable records with data in binary, BCD, Packed Decimal, EBCDIC, ASCII, floating, fixed point, exponential, field justified, etc. etc. Even variable number of fields per record! **$225/$25**

☐ Ⓛ **SUPER-SORT II** — Above available as absolute program only **$175/$25**

☐ Ⓛ **SUPER-SORT III** — As II without SELECT/EXCLUDE **$125/$25**

☐ Ⓛ **WORD-STAR** — Menu driven visual word processing system for use with standard terminals. Text formatting performed on screen. Facilities for text paginate, page number, justify, center and underscore. User can print one document while simultaneously editing a second. Edit facilities include global search and replace, read/write to other text files, block move, etc. Requires CRT terminal with addressable cursor positioning **$445/$25**

☐ Ⓛ **WORD-MASTER** Text Editor — In one mode has superset of CP/M's ED commands including global searching and replacing, forward and backwards in file. In video mode, provides full screen editor for users with serial addressable-cursor terminal **$125/$25**

SOFTWARE SYSTEMS

☐ Ⓜ **CBASIC-2** Disk Extended BASIC — Non-interactive BASIC with pseudo-code compiler and runtime interpreter. Supports full file control, chaining, integer and extended precision variables, etc. **$109/$15**

☐ Ⓛ Ⓜ **PASCAL/Z** — Z-80 native code PASCAL compiler. Produces optimized, ROMable re-entrant code. All interfacing to CP/M is through the support library. The package includes compiler, companion macro-assembler and source for the library. Requires 56K and Z-80 CPU.
Version 2 Includes all of Jensen/Wirth except variant records. **$275/$25**
Version 3 Upgrade with variant records and strings expected 2/80. **$395/$25**

☐ Ⓜ **PASCAL/MT** — Subset of standard PASCAL. Generates ROMable 8080 machine code. Symbolic debugger included. Supports interrupt procedures and BCD arithmetic for real variables. CP/M file I/O and assembly language interface supported. Lacks Sets, Enumeration and Record data types. Manual explains BASIC to PASCAL conversion. Requires 32K **$95/$30**
Source for PASCAL/MT run time package. Requires MAC. (See under Digital Research.) **$50**

Structured Systems prices are discounted!

STRUCTURED SYSTEMS GROUP

☐ **GENERAL LEDGER** — Interactive and flexible system providing proof and report outputs. Customization of COA created interactively. Multiple branch accounting centers. Extensive checking performed at data entry for proof, COA correctness, etc. Journal entries may be batched prior to posting. Closing procedure automatically backs up input files. All reports can be tailored as necessary. Requires CBASIC-2 **$899/$25**

☐ **ACCOUNTS RECEIVABLE** — Open item system with output for internal aged reports and customer-oriented statement and billing purposes. On-Line Enquiry permits information for Customer Service and Credit departments. Interface to General Ledger provided if both systems used. Requires CBASIC-2 **$699/$25**

☐ **ACCOUNTS PAYABLE** — Provides aged statements of accounts by vendor with check writing for selected invoices. Can be used alone or with General Ledger and/or with NAD. Requires CBASIC-2 **$699/$25**

☐ **ANALYST** — Customized data entry and reporting system. User specifies up to 75 data items per record. Interactive data entry, retrieval and update facility makes information management easy. Sophisticated report generator provides customized reports using selected records with multiple level break-points for summarization. Requires CBASIC-2, 24 x 8 CRT, printer and 48K system. **$225/$15**

☐ **LETTERIGHT** — Program to create, edit and type letters or other documents. Has facilities to enter, display, delete and move text, with good video screen presentation. Designed to integrate with NAD for form letter mailings. Requires CBASIC-2 **$179/$25**

☐ **NAD** Name and Address selection system — interactive mail list creation and maintenance program with output as full reports with reference data or restricted information for mail labels. Transfer system for extraction and transfer of selected records to create new files. Requires CBASIC-2 **$79/$20**

☐ **QSORT** — Fast sort/merge program for files with fixed record length, variable field length information. Up to five ascending or descending keys. Full back-up of input files created. **$95/$20**

Graham-Dorian prices are discounted!

GRAHAM-DORIAN SOFTWARE SYSTEMS

Software with Manual / Manual Alone

☐ Ⓛ Ⓜ **GENERAL LEDGER** — An on-line system; no batching is required. Entries to other GRAHAM-DORIAN accounting packages are automatically posted. User establishes customized C.O.A. Provides transaction register, record of journal entries, trial balances and monthly closings. Keeps 14 month history and provides comparison of current year with previous year. Requires CBASIC-2. Supplied in source **$495/$35**

☐ Ⓛ Ⓜ **ACCOUNTS PAYABLE** — Maintains vendor list and check register. Performs cash flow analysis. Flexible — writes checks to specific vendor for certain invoices or can make partial payments. Automatically posts to GRAHAM-DORIAN general ledger or runs as stand alone system. Requires CBASIC-2. Supplied in source. **$495/$35**

☐ Ⓛ Ⓜ **ACCOUNTS RECEIVABLE** — Creates trial balance reports, prepares statements, ages accounts and records invoices. Provides complete information describing customer payment activity. Receipts can be posted to different ledger accounts. Entries automatically update GRAHAM-DORIAN general ledger or runs as stand alone system. Requires CBASIC-2. Supplied in source. **$495/$35**

☐ Ⓛ Ⓜ **PAYROLL SYSTEM** — Maintains employee master file. Computes payroll withholding for FICA, Federal and State taxes. Prints payroll register, checks, quarterly reports and W-2 forms. Can generate ad hoc reports and employee form letters with mail labels. Requires CBASIC. Supplied in source code. **$495/$35**

☐ Ⓛ Ⓜ **INVENTORY SYSTEM** — Captures stock levels, costs, sources, sales, ages, turnover, markup, etc. Transaction information may be entered for reporting by salesman, type of sale, date of sale, etc. Reports available both for accounting and decision making. Requires CBASIC. Supplied in source code. **$495/$35**

☐ Ⓛ Ⓜ **JOB COSTING** — Designed for general contractors. To be used interactively with other GRAHAM-DORIAN accounting packages for tracking and analysing expenses. User establishes customized cost categories and job phases. Permits comparison of actual versus estimated costs. Automatically updates GRAHAM-DORIAN general ledger or runs as stand alone system. Requires CBASIC-2. Supplied in source. **$495/$35**

☐ Ⓛ Ⓜ **APARTMENT MANAGEMENT SYSTEM** — Financial management system for receipts and security deposits of apartment projects. Captures data on vacancies, revenues, etc. for annual trend analysis. Daily report shows late rents, vacancy notices, vacancies, income lost through vacancies, etc. Requires CBASIC. Supplied in source code. **$495/$35**

☐ Ⓛ Ⓜ **CASH REGISTER** — Maintains files on daily sales. Files data by sales person and item. Tracks sales, overrings, refunds, payouts and total net deposits. Requires CBASIC. Supplied in source code **$495/$35**

☐ **tiny C** — Interactive interpretive system for teaching structured programming techniques. Manual includes full source listings **$75/$40**

☐ Ⓜ **BDS C COMPILER** — Supports most major features of language, including Structures, Arrays, Pointers, recursive function evaluation, linkable with library to 8080 binary output. Lacks data initialization, long & float type and static & register class specifiers. Documentation includes "C" Programming Language book by Kernighan & Ritchie **$110/$15**

☐ Ⓛ **WHITESMITHS' C COMPILER** — The ultimate in systems software tools. Produces faster code than Pascal with more extensive facilities. Conforms to the full UNIX*** Version 7 C language, described by Kernighan and Ritchie, and makes available over 75 functions for performing I/O, string manipulation and storage allocation. Linkable to Microsoft REL files. Requires 60K CP/M **$630/$30**

☐ Ⓜ **POLYVUE/80** — Full screen editor for any CRT with XY cursor positioning. Includes vertical and horizontal scrolling, interactive search and replace, automatic text wrap around for word processing, operations for manipulating blocks of text, and comprehensive 70 page manual. **$135/$15**

☐ Ⓜ **POLYTEXT/80** — Text formatter for word processing applications. Justifies and paginates source text files. Will generate form letters with custom fields and conditional processing. Support for Daisy Wheel printers includes variable pitch justification and motion optimization. **$85/$15**

☐ **ALGOL-60** — Powerful block-structured language compiler featuring economical run time dynamic allocation of memory. Very compact (24K total RAM) system implementing almost all Algol 60 report features plus many powerful extensions including string handling direct disk address I/O etc. Requires Z80 CPU **$199/$20**

Prices and specifications subject to change without notice.

Software with Manual / Manual Alone

☐ Ⓜ **Z80 DEVELOPMENT PACKAGE** — Consists of: (1) disk file line editor, with global inter and intra-line facilities; (2) Z80 relocating assembler, Zilog/Mostek mnemonics, conditional assembly and cross reference table capabilities; (3) linking loader producing absolute Intel hex disk file. **$95/$20**

☐ Ⓜ **ZDT** — Z80 Debugger to trace, break and examine registers with standard Zilog/Mostek mnemonic disassembly displays. $35 when ordered with Z80 Development Package **$50/$10**

☐ Ⓜ **DISTEL** — Disk based disassembler to Intel 8080 or TDL/Xitan Z80 source code, listing and cross reference files. Intel or TDL/Xitan pseudo ops optional. Runs on 8080. **$65/$10**

☐ Ⓜ **DISILOG** — As DISTEL to Zilog Mostek mnemonic files. Runs on Z80 only **$65/$10**

☐ Ⓜ **TEXTWRITER III** — Text formatter to justify and paginate letters and other documents. Special features include insertion of text during execution from other disk files or console, permitting recipe documents to be created from linked fragments on other files. Has facilities for sorted index, table of contents and footnote insertions. Ideal for contracts, manuals, etc. **$125/$20**

☐ Ⓜ **POSTMASTER** — A comprehensive package for mail list maintenance. Features include keyed record extraction and label production. A form letter program is included which provides neat letters on single sheet or continuous forms. Requires CBASIC-2 **$150/$25**

☐ Ⓜ **WHATSIT?**** Interactive data-base system using associative tags to retrieve information by subject. Hashing and random access used for fast response. Requires CBASIC-2 **$125/$25**

☐ Ⓜ **XYBASIC** Interactive Process Control BASIC — Full disk BASIC features plus unique commands to handle bytes, rotate and shift, and to test and set bits. Available in Integer, Extended and ROMable versions.
Integer Disk or Integer ROMable **$295/$25**
Extended Disk or Extended ROMable **$395/$25**

☐ Ⓜ **SMAL/80** Structured Macro Assembled Language — Package of powerful general purpose text macro processor and SMAL structured language compiler. SMAL is an assembler language with IF-THEN-ELSE, LOOP-REPEAT-WHILE, DO-END, BEGIN-END constructs **$75/$15**

☐ Ⓜ **SELECTOR III-C2** — Data Base Processor to create and maintain multi Key data bases. Prints formatted, sorted reports with numerical summaries or mailing labels. Comes with sample applications including Sales Activity, Inventory, Payables, Receivables, Check Register, and Client/Patient Appointments, etc. Requires CBASIC Version 2. Supplied in source code. **$295/$20**

☐ **CPM/374X** — Has full range of functions to create or re-name an IBM 3741 volume, display directory information and edit the data set contents. Provides full file transfer facilities between 3741 volume data sets and CP/M files **$195/$10**

☐ Ⓜ **BASIC UTILITY DISK** — Consists of: (1) CRUNCH-14 – Compacting utility to reduce the size and increase the speed of programs in Microsoft Basic and TRS-80 Basic. (2) DPFUN – Double precision subroutines for computing nineteen transcendental functions including square root, natural log, log base 10, sin, arc sin, hyperbolic sin, hyperbolic arc sin, etc. Furnished in source on diskette and documentation **$50/$35**

☐ Ⓜ **THE STRING BIT** — Fortran character string handling. Routines to find, fill, pack, move, separate, concatenate and compare character strings. This package completely eliminates the problems associated with character string handling in FORTRAN. Supplied with source **$45/$15**

☐ Ⓜ **BSTAM** — Utility to link one computer to another also equipped with BSTAM. Allows file transfers at full data speed (no conversion to hex), with CRC block control check for very reliable error detection and automatic retry. We use it; it's great! Full wildcard expansions to send * .COM, etc. 9600 baud with wire, 300 baud with phone connection. Both ends need one. Standard and M versions can talk to one another. Compatible TRSDOS version also available **$150/$5**

☐ **Flippy Disk Kit** — Template and instructions to modify single sided 5¼" diskettes for use of second side in single sided drives **$12.50**

☐ **FLOPPY SAVER** Protection for center holes of 5¼" floppy disks. Only 1 needed per diskette. Kit contains centering post, pressure tool, tough 7-mil mylar reinforcing rings. Installation tools and rings for 25 diskettes. **$14.95**
Re-orders of rings only **$7.95**

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**Z80 is a trademark of Zilog, Inc.
***UNIX is a trademark of Bell Laboratories.
****WHATSIT? is a trademark of Computer Headware.

†CP/M for Heath, TRS-80 Model I and PolyMorphic 8813 are modified and must use specially compiled versions of system and applications software

Ⓜ Modified version available for use with CP/M as implemented on Heath and TRS-80 Model I computers.

Ⓛ User license agreement for this product must be signed and returned to Lifeboat Associates before shipment may be made.

Shopping List No.8

Software for most popular 8080/Z80 computer disk systems including

***NORTH STAR, iCOM, MICROPOLIS, DYNABYTE DB8/2 & DB8/4, EXIDY SORCERER, SD SYSTEMS, ALTAIR, VECTOR MZ, MECCA, 8" IBM, HEATH H17 & H89, HELIOS, IMSAI VDP42 & 44, REX, NYLAC, INTERTEC, VISTA V80** and **V200, TRS-80 MODEL I** and **MODEL II, ALTOS, OHIO SCIENTIFIC** and **IMS 5000** formats.*



TM

Orders must specify disk systems and formats: e.g. North Star single, double or quad density, IBM single or 2D/256, Altair, Helios II, Micropolis Mod I or II, 5¼" soft sector (Micro iCOM/SD Systems Dynabyte), etc.

Prices F.O.B. New York. Shipping, handling and C.O.D. charges extra.

Manual cost applicable against price of subsequent software purchase.

The sale of each propriety software package conveys a license for use on one system only.

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(212) 580-0082 Telex: 220501 *(New number!)*

```
                144D  000E A
                144E  0015 A
 97             144F  0071 A              MOV     M,C
 98             1450  0001 A  CRRT       LXI     B,1
                1451  0001 A
                1452  0000 A
 99                          *                                       ADJUST CURSOR POINTER
100             1453  0009 A  CRADJ      DAD     B
101                         *                                       CHECK FOR OVERFLOW
102             1454  007C A              MOV     A,H
103             1455  00FE A              CPI     VID+2
                1456  0006 A
104             1457  00C2 A              JNZ     VIDRT
                1458  0066 A
                1459  0014 A
105             145A  0026 A              MVI     H,VID+1
                145B  0005 A
106             145C  007D A              MOV     A,L
107             145D  00F6 A              ORI     X'E0'
                145E  00E0 A
108             145F  006F A              MOV     L,A
109             1460  00CD A              CALL    ROLLO
                1461  00B1 A
                1462  0014 A
110             1463  00C3 A              JMP     VIDR1
                1464  006C A
                1465  0014 A
111                         *                                       COMMON EXIT CODE
112                         *                                       NORMALIZE CURSOR POINTER
113             1465  007C A  VIDRT      MOV     A,H
114             1467  00E6 A              ANI     3
                1468  0003 A
115             1469  00C6 A              ADI     VID
                146A  0004 A
116             146B  0067 A              MOV     H,A
117             146C  00CD A  VIDR1      CALL    DELAY
                146D  000E A
                146E  0015 A
118             146F  007E A              MOV     A,M             CHARACTER UNDER THE CURSOR
119             1470  00CD A              CALL    DELAY
                1471  000E A
                1472  0015 A
120             1473  00CD A              CALL    CURSOR          CURSOR
                1474  0028 A
                1475  0015 A
121             1476  00EB A              XCHG                    POINTER TO DE
122             1477  0077 A              MOV     M,A             CHARACTER UNDER THE CURSOR
123             1478  002B A              DCX     H
124             1479  0072 A              MOV     M,D             HPTR
125             147A  002B A              DCX     H
126             147B  0073 A              MOV     M,E             LPTR
127                         *                                       RESTORE REGISTERS AND EXIT
128             147C  00F1 A              POP     PSW
129             147D  00C1 A              POP     B
130             147E  00D1 A              POP     D
131             147F  00E1 A              POP     H
132             1480  00C9 A              RET
133                         *                                       PROCESS FORM FEED
134                         *                                       FILL SCREEN WITH SPACES
135                         *                                       MOVE CURSOR TO TOP LEFT
136             1481  0021 A  VIDFF      LXI     H,VIDH
                1482  0000 A
                1483  0004 A
137             1484  00E5 A              PUSH    H
138             1485  00CD A  VIDFC      CALL    DELAY           WAIT THE SET NUMBER OF MILLISECONDS
                1486  000E A
                1487  0015 A
139             1488  0036 A              MVI     M,32
                1489  0020 A
140             148A  0023 A              INX     H
141             148B  007C A              MOV     A,H
142             148C  00FE A              CPI     VID+2
                148D  0006 A
143             148E  00DA A              JC      VIDFC
                148F  0085 A
                1490  0014 A
144             1491  00E1 A              POP     H
145                         *                                       PROCESS CARRIAGE RETURN
146                         *                                       MOVE CURSOR TO BEGINNING OF LINE
147             1492  007D A  VIDCR      MOV     A,L
148             1493  00E6 A              ANI     X'E0'
                1494  00E0 A
149             1495  006F A              MOV     L,A
150             1496  00C3 A              JMP     VIDRT
                1497  0066 A
                1498  0014 A
151                         *                                       PROCESS LINE FEED
152                         *                                       MOVE CURSOR DOWN ONE LINE
153                         *                                       FILL NEW LINE WITH SPACES
154             1499  00D5 A  VIDLF      PUSH    D
155             149A  0011 A              LXI     D,32
                149B  0020 A
                149C  0000 A
156             149D  0019 A              DAD     D
157             149E  007C A              MOV     A,H
158             149F  00FE A              CPI     VID+2
                14A0  0006 A
159             14A1  00C2 A              JNZ     VDLF3
                14A2  00CE A
                14A3  0014 A
160                         *                                       ROLL THE WHOLE DISPLAY UP ONE LINE
161             14A4  00CD A              CALL    ROLLO
                14A5  00B1 A
                14A6  0014 A
162             14A7  007D A              MOV     A,L
163             14A8  00F6 A              ORI     X'E0'
                14A9  00E0 A
164             14AA  006F A              MOV     L,A
165             14AB  0026 A              MVI     H,VID+2
                14AC  0006 A
166             14AD  00D1 A              POP     D
167             14AE  00C3 A              JMP     VIDRT
                14AF  0066 A
                14B0  0014 A
168                         ************************************************************************
169                         *                                                                      *
170                         *                          ROLL SUBROUTINE                             *
171                         *                                                                      *
172                         ************************************************************************
173             14B1  00D5 A  ROLLO      PUSH    D
```

synchronization ($\overline{FS}$) signal, which is low during vertical blanking on the horizontal sync ($\overline{HS}$) signal, which is low during horizontal retrace. During this time the memory contents can be altered without causing the screen to flicker. Since the $\overline{HS}$ signal goes low more often, the screen can be updated faster when using this signal.

Circuit Description

Fig. 1 shows the complete circuit required to implement the VDG for connection to a black and white or color TV. The 74LS85 decodes the high-order address lines according to the setting of the DIP switch. The video display memory can be located anywhere in memory. When the video display memory is accessed by the microprocessor for either a read or write, the VDG memory select ($\overline{MS}$) pin is forced low. This action disables the VDG address lines and enables the 74LS244, 74lS245 and 74LS367A to allow the microprocessor to go in and read or write to the 2114 memory.

An 8255 programmable peripheral interface is used to select among the twelve VDG modes and to sense when $\overline{HS}$ or $\overline{FS}$ is low.

The video clock (VC) generated at pin 27 determines the horizontal width of display. It should be adjusted for about 6 MHz. You can adjust it by picking the capacitor connected to pin 27 of the VDG to give the proper display width.

Half of a 74LS157 data selector is used to allow D7 to invert a character and D6 to select the background color during the alphanumeric mode.

Finally, the four outputs of the VDG go directly into an MC1372 color TV video modulator that is tuned to output the video signal directly on Channel 3 or 4, depending on the value of the capacitor across the inductor. For Channel 3 it is 75 pF, and for Channel 4, 56 pF. A standard 3.58 MHz color TV crystal connects to the MC1373 to provide the proper timing for both the MC1372 and the VDG. If you have a black and white monitor, pin 9 of the VDG can be connected through a decoupling ca-

pacitor directly to your composite video input, eliminating the need for the MC1372. The video monitor output is used in Fig. 1.

For the alphanumeric mode, any control, such as cursor control, line feed, carriage return, form feed and home, can be implemented by the appropriate software routine, preferably located in some type of nonvolatile storage such as EPROM. Included in Listing 1 is a list of 8080A assembly language that will simulate most common control characters. This routine assumes your video memory starts at hex 400.

Construction

As my system uses a nonstandard wire-wrap board, I did not build my display circuitry on an S-100 breadboard card. You can build this circuitry on any card you desire; however, I recommend using wire-wrap construction. Use the component side of the board for the +5 V supply and the bottom side of the board for the ground plane. Install 0.1 uF decoupling capacitors throughout the board at the rate of one per two TTL chips. It is a good idea to enclose the color video modulator circuitry (denoted by the dotted line in Fig. 1) in a shielded enclosure to prevent the rf from leaking out onto your neighbor's TV. Photo 1 shows the completed circuit.

The parts list in Table 2 uses low-power Schottky TTL. Note that the memory chips should have an access time of less than 500 ns due to the speed requirements of the VDG.

After wiring up the board, but before plugging in the ICs, it is wise to apply power to the board and to measure the supply voltages at each IC to assure proper polarity.

You may need to adjust the 5k pot on pin 3 of the MC1372. This adjustment controls the duty cycle of the MC1372. Adjust it by watching the TV screen. The capacitor connected to the input of the VDG determines the width of the picture. Select this one also by watching the screen.

Make sure you disconnect your antenna before connecting

```
174   14B2  00E5 A          PUSH    H
175   14B3  0011 A          LXI     D,VIDH
      14B4  0000 A
      14B5  0004 A
176   14B5  0021 A          LXI     H,VIDH+32
      14B7  0020 A
      14B8  0004 A
177   14B9  00CD A  ROLL1    CALL    DELAY           WAIT THE SET NUMBER OF MILLISECONDS
      14BA  000E A
      14BB  0015 A
178   14BC  007E A          MOV     A,M
179   14BD  0012 A          STAX    D
180   14BE  00CD A          CALL    DELAY           WAIT THE SET NUMBER OF MILLISECONDS
      14BF  000E A
      14C0  0015 A
181   14C1  0036 A          MVI     M,32
      14C2  0020 A
182   14C3  0013 A          INX     D
183   14C4  0023 A          INX     H
184   14C5  007C A          MOV     A,H
185   14C6  00FE A          CPI     VID+2           VID + 512
      14C7  0006 A
186   14C8  00C2 A          JNZ     ROLL1
      14C9  00B9 A
      14CA  0014 A
187   14CB  00E1 A          POP     H
188   14CC  00D1 A          POP     D
189   14CD  00C9 A          RET
190                 *                             FILL NEW LINE WITH SPACES
191   14CE  00E5 A  VDLF3    PUSH    H
192   14CF  007D A          MOV     A,L
193   14D0  00E6 A          ANI     X'E0'
      14D1  00E0 A
194   14D2  006F A          MOV     L,A
195   14D3  00CD A  VDLF4    CALL    DELAY           WAIT THE SET NUMBER OF MILLISECONDS
      14D4  000E A
      14D5  0015 A
196   14D6  0036 A          MVI     M,32
      14D7  0020 A
197   14D8  0023 A          INX     H
198   14D9  001D A          DCR     E
199   14DA  00C2 A          JNZ     VDLF4
      14DB  00D3 A
      14DC  0014 A
200   14DD  00E1 A          POP     H
201   14DE  00D1 A          POP     D
202   14DF  00C3 A          JMP     VIDRT
      14E0  0066 A
      14E1  0014 A
203                 *                             THE FOLLOWING INSTRUCTIONS ALONG WITH
204                 *                             THOSE MARKED YYYY ABOVE, MAY BE REMOVED
205                 *                             IF CURSOR CONTROL IS NOT REQUIRED.
206                 ********************************************************************************
207                 *                                                                              *
208                 *          CURSOR CONTROL PROCESSING                                           *
209                 *                                                                              *
210                 ********************************************************************************
211   14E2  0001 A  CRUP     LXI     B,-32           YYYY
      14E3  00E0 A
      14E4  00FF A
212   14E5  00C3 A          JMP     CRADJ           YYYY
      14E6  0053 A
      14E7  0014 A
213   14E8  0001 A  CRDN     LXI     B,32            YYYY
      14E9  0020 A
      14EA  0000 A
214   14EB  00C3 A          JMP     CRADJ           YYYY
      14EC  0053 A
      14ED  0014 A
215   14EE  0001 A  CRLT     LXI     B,-1            YYYY
      14EF  00FF A
      14F0  00FF A
216   14F1  00C3 A          JMP     CRADJ           YYYY
      14F2  0053 A
      14F3  0014 A
217   14F4  0021 A  CRHM     LXI     H,0             YYYY
      14F5  0000 A
      14F6  0000 A
218   14F7  00C3 A          JMP     VIDRT           YYYY
      14F8  0066 A
      14F9  0014 A
219   14FA  00CD A  INVERT   CALL    DELAY           WAIT THE SET NUMBER OF MILLISECONDS
      14FB  000E A
      14FC  0015 A
220   14FD  007E A          MOV     A,M             THIS IS THE INVERT ROUINTE
221   14FE  00E6 A          ANI     X'7F'
      14FF  007F A
222   1500  002F A          CMA
223   1501  00E6 A          ANI     X'80'
      1502  0080 A
224   1503  00CD A          CALL    DELAY           WAIT THE SET NUMBER OF MILLISECONDS
      1504  000E A
      1505  0015 A
225   1506  0086 A          ADD     M
226   1507  00CD A          CALL    DELAY           WAIT THE SET NUMBER OF MILLISECONDS
      1508  000E A
      1509  0015 A
227   150A  0077 A          MOV     M,A
228   150B  00C3 A          JMP     CRRT
      150C  0050 A
      150D  0014 A
229                 ********************************************************************************
230                 *                                                                              *
231                 *          DELAY SUBROUTINE                                                    *
232                 *                                                                              *
233                 ********************************************************************************
234   150E  00C5 A  DELAY    PUSH    B               THIS IS THE DELAY ROUTINE
235   150F  00F5 A          PUSH    PSW
236   1510  003A A          LDA     WAIT            GET DELAY FOR BAUD RATE SYNTHESIS
      1511  0024 A
      1512  0000 A
237   1513  003D A  DLY1     DCR     A
238   1514  00C2 A          JNZ     DLY1
      1515  0013 A
      1516  0015 A
239   1517  00DB A  HIGH     IN      X'12'           GET THE HORIZONTAL SYNC SIGNAL
      1518  0012 A
240   1519  00E6 A          ANI     1               AND WAIT UNTIL IT IS HIGH
      151A  0001 A
241   151B  00CA A          JZ      HIGH
      151C  0017 A
```

```
          151D  0015 A
242       151E  00DB A  LOW      IN      X'12'          NOW WAIT UNTIL IT IS LOW
          151F  0012 A
243       1520  00E6 A           ANI     1
          1521  0001 A
244       1522  00C2 A           JNZ     LOW
          1523  001E A
          1524  0015 A
245       1525  00F1 A           POP     PSW            WE HAVE WAITED LONG ENOUGH
246       1526  00C1 A           POP     B
247       1527  00C9 A           RET
248       1528  00E6 A  CURSOR   ANI     X'7F'          THIS SUBROUTINE INVERTS THE CHAR CURSOR
          1529  007F A
249       152A  002F A           CMA
250       152B  00E6 A           ANI     X'80'
          152C  0080 A
251       152D  00CD A           CALL    DELAY
          152E  000E A
          152F  0015 A
252       1530  0086 A           ADD     M
253       1531  00CD A           CALL    DELAY
          1532  000E A
          1533  0015 A
254       1534  0077 A           MOV     M,A
255       1535  00C9 A           RET
256                              END
```

Designation	Part Number	Description
IC1	74LS245N	Tri-state octal transceiver
IC2	74LS244N	Tri-state octal buffer
IC3, 22	74LS00N	Quad NAND gate
IC4, 21	74LS367AN	Tri-state hex buffer
IC5	74LS85N	4-bit magnitude comparator
IC6	8255	Programmable peripheral interface
IC7	74LS157N	Quad 2:1 data selector
IC8	S68047P	AMI video display generator
IC10-15, 26-31	2114	1K × 4 static RAM, 500 ns or faster
IC19	MC1372P	Color TV video modulator
IC24	74LS139	Dual 2 of 4 decoder
X1	3.579545 MHz	Color TV crystal
		Misc. resistors, capacitors, inductor, board, DIP switch

Table 2. Parts list.

the rf output to your TV. Otherwise, you may radiate your signal all over the neighborhood as well as violate FCC regulations.

Operation

Listing 1 shows an example of a typical subroutine to simulate the common control functions for the alphanumeric mode. If you use a different address for the display memory or assign different control character codes, you will have to make the appropriate changes in the software, which is well documented enough to allow you to see where these changes should be made. I have not included any software for controlling the VDG in the full-graphics mode, but you can develop this yourself.

The routine normally waits until the screen is blanked ($\overline{HS}$ is low) before altering the display memory to prevent the screen from flickering. To use the video driver routine in your 8080, place the desired character or control function in the C register and call the subroutine. The subroutine returns with all registers intact.

Conclusion

The circuit described lets you exercise the full capabilities of the VDG. It allows you to build a memory-mapped CRT controller with a minimum of support hardware. You can easily build this circuit in stages using the circuit as a basic TTY at first and adding more memory and software to utilize the full capabilities of the VDG. ■

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This article describes an inexpensive digital cassette tape-index counter that can be added to the built-in data-cassette unit on the PET 2001 personal computer. An index counter such as this gives the user a means to locate programs and data files quickly and efficiently with a high degree of accuracy. The slow data-transfer rate of a digital tape recorder, as compared to that of a floppy disk, should not be compounded with time-consuming hit-and-miss loading techniques. In my experience, the counter allows faster loading and saving of data, thus giving more time for programming and debugging.

Introduction

There are many attractive features about the Commodore PET 2001 computer. I was impressed by the graphics capabilities of the computer, the fast and versatile resident BASIC and a digital tape-storage system under partial software control, among others. I went to my local computer store and bought a PET.

After initially using the computer, I found that the keyboard, not being set up like a standard typewriter keyboard, was the greatest obstacle. However, after I typed several thousand lines of BASIC, the keyboard became easily tolerable!

Now, a new problem assumed the place of the old, as is always the case. Most programs are of varying lengths and therefore occupy corresponding amounts of cassette tape. How do we locate programs not at the beginning of a tape accurately, without resorting to slow serial access or using virtually blind fast-forward and rewind techniques? That was the question!

The answer was apparent after I glanced at my stereo system and noted the mechanical digital counters used on audio tape recorders. I resolved to add a tape-index counter to my data cassette. For reasons of compatibility, I chose the counter found on the Sony TC-160 cassette tape deck.

Counter Modification

This particular counter can be purchased for a few dollars at most Sony service and distribution centers. The drive mechanism is designed to accept a rubber belt as opposed to some worm-gear mechanisms I have seen. It is quite accurate in all regular and fast modes of operation of the tape recorder. An added bonus is a zero-reset function (see Photo 1).

The only modification to the counter itself is to the nylon pulley on the drive shaft. The 0.65 inch diameter of the pulley allows the counter to only reach a maximum count of about 300 on one side of a C-60 cassette tape. Since this is the largest cassette you should use in data-transfer applications, due to tape stretching on longer tapes, the pulley could

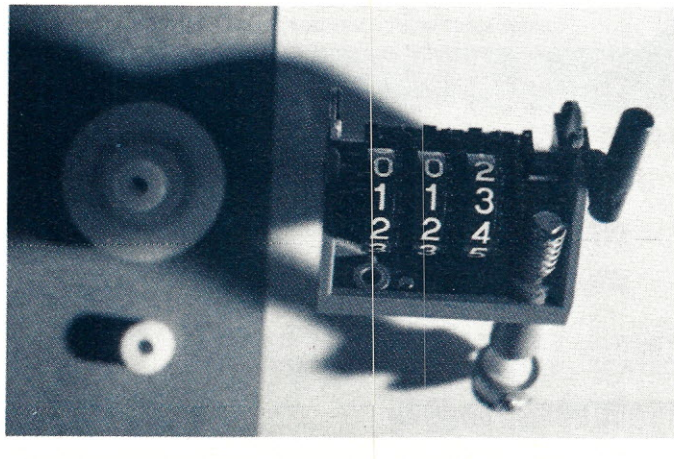


Photo 1. Digital counter with original nylon pulley removed and brass pulley installed.

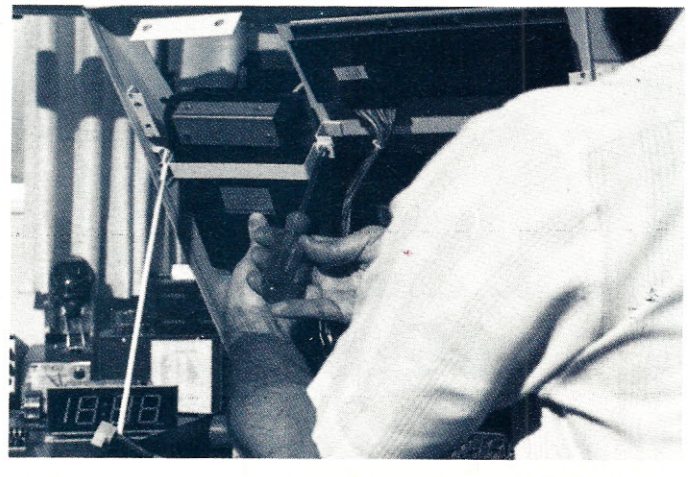


Photo 2. Removal of cassette recorder from computer.

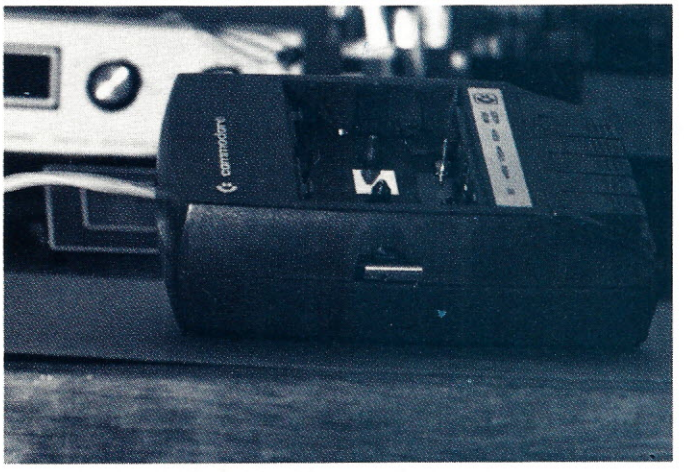


Photo 3. Cassette lid removal facilitates alignment of cutout in case with rewind capstan.

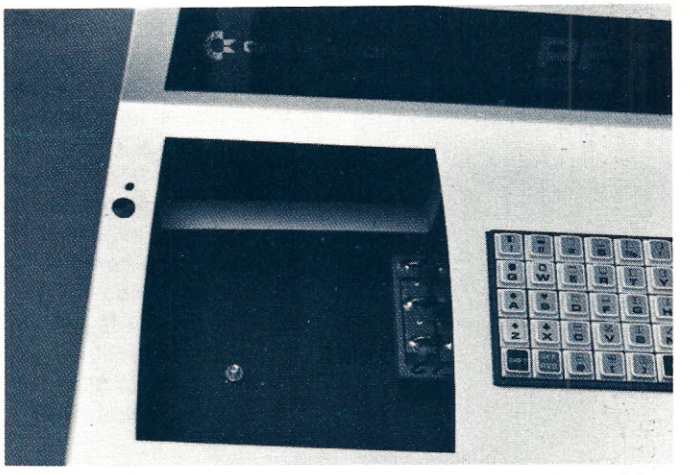


Photo 4. Drilled holes in computer front panel for digital counter shaft and mounting screw.

be one-third the diameter and thereby triple the previously mentioned maximum count. This increases the accuracy of the counter from approximately six seconds per digit to two seconds per digit.

The PET allows 7.5 seconds of tape header between programs. Therefore, within three to four digits, a program could be indexed, located and loaded in a matter of seconds without fear of overshooting.

As shown in Photo 1, the pulley used can be from a junkbox cassette recorder. The brass pulley on the shaft of the synchronous drive motor is of a standard dimension and is held in place by means of setscrews. The hole in the brass pulley is enlarged by drilling to accommodate the larger shaft of the counter. The original nylon pulley on the counter is pried off carefully.

Cassette Recorder Reassembly

The next step in adding the counter is to modify the PET digital cassette recorder to accept the drive belt that will drive the counter. The computer must be opened up at this stage to access the recorder. There are two screws on each side near the front of the computer which secure the top section of the computer to the black metal base. With these removed, it is possible to raise the hinged top of the computer similar to opening the hood of a car. A steel rod is provided on the left side to prop open the computer for servicing. It is important that the computer be switched off and unplugged before you open the computer.

Before you unplug the multiwire cable from the cassette recorder to the microprocessor board, note how it is plugged in; it can be plugged in two ways! Then remove the two large screws at the front of the recorder. The steel bracket will still hold the unit in place.

While holding the cassette recorder with one hand, unscrew the bracket at the right side of the unit. This screw can be loosened without removing it and still allow the recorder to slide carefully away from you toward the back of the computer. Once it has cleared the bracket, it can be lowered and pulled out under the bracket (see Photo 2).

The bottom section of the cassette recorder is attached by three screws. At a position directly left of the rewind capstan, as shown in Photo 3, a hole is carved. This is where the belt drive will exit the recorder. An X-acto knife works well if you shave off small sections at a time. A file creates too much dust!

This procedure may take a half hour or more, so be patient. Care should be taken so as not to allow shavings to lodge in the recorder mechanism. Then draw a vertical pencil mark, horizontally in line with the two tape capstans, on the outside of the case. Align the shaft of the counter with this mark.

With the cassette recorder reinstalled in the computer, the pencil mark should be visible from the top of the computer.

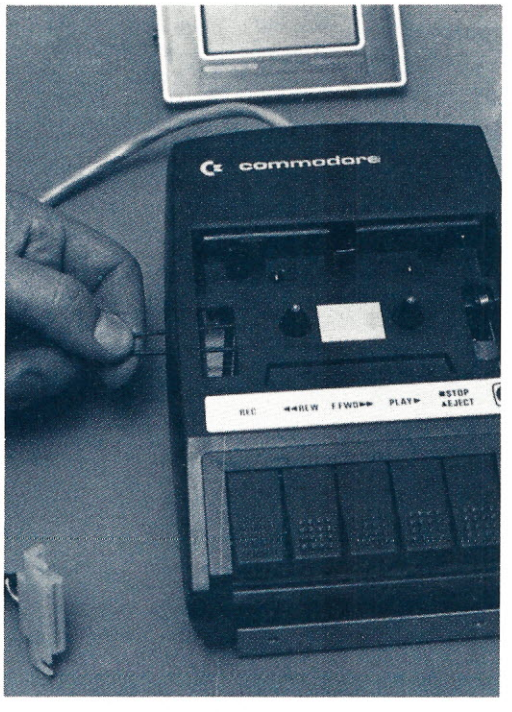


Photo 5. Installation of O-ring in groove already present on rewind capstan.

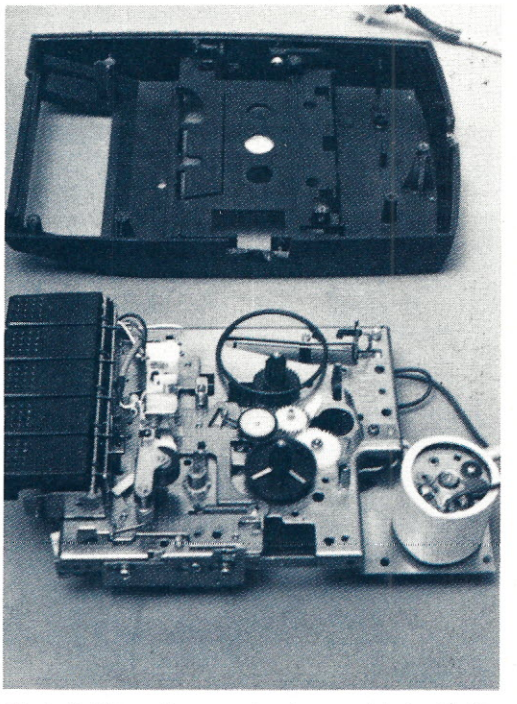


Photo 6. Cassette recorder reassembled with the O-ring exiting through a cutout in the side of the case.



Photo 7. With the cassette recorder reinstalled in the computer, and the counter affixed to the front panel, the O-ring is slipped onto the brass pulley.

This is where you should drill the large hole for the counter shaft in the computer panel. The two holes must be drilled on the computer front panel as shown in Photo 4. The smaller hole is for a 5-44 1/4 inch screw to secure the counter to the panel. These holes should be drilled while the cassette recorder is removed. Exercise caution so as not to get any metal chips or dust on the motherboard. It is a good idea to cover the board with a plastic sheet.

The ideal way to drive the counter is with an O-ring. Rubber O-rings are inexpensive, strong and come in a variety of standard sizes. I purchased several sizes of O-rings and found a perfect fit with a 1.739 inch diameter and 0.09 inch cross-section. If a Precision O-ring catalog is available, the above-mentioned O-ring is #031. To compensate for slight differences in counter installations, an O-ring between 1.364 and 1.989 inches diameter should be appropriate. These O-rings are catalog numbers 028-033.

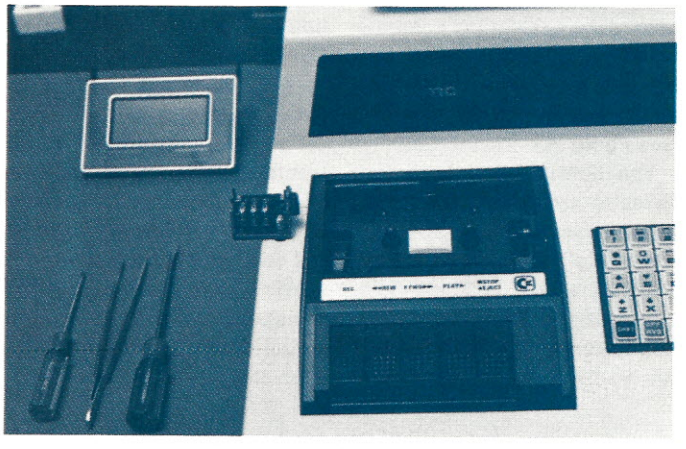


Photo 8. Top view of completed assembly. Since counter protrudes over edge of computer, mounting holes on bottom of counter can be used to secure cover or escutcheon.

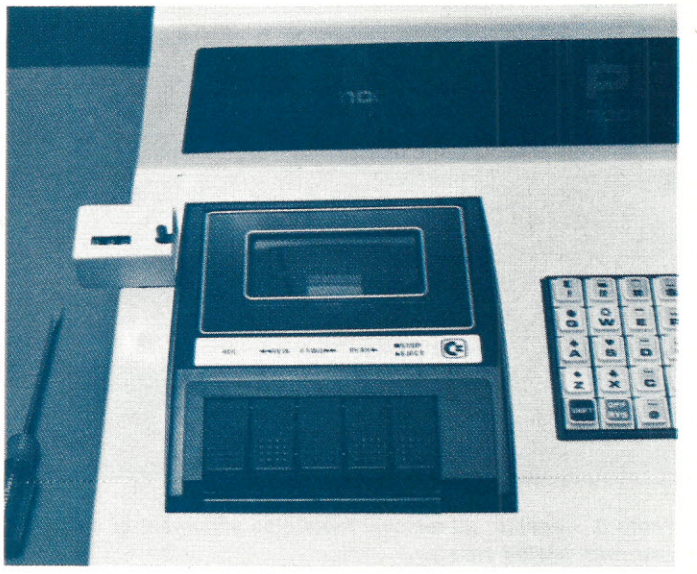


Photo 9. Escutcheon on counter secured by two screws on underside.

Final Assembly

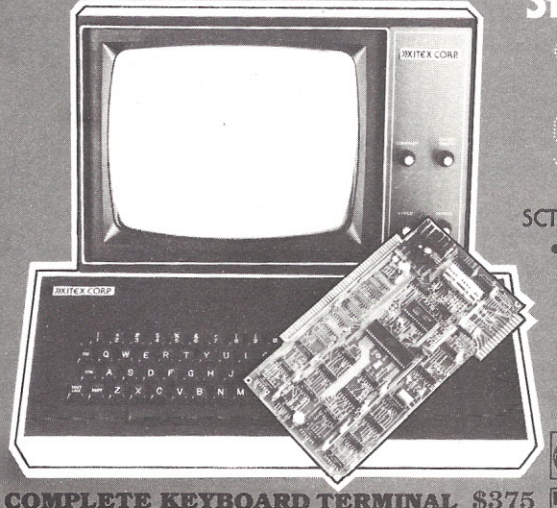
Photo 5 shows the interior of the cassette recorder with the chassis removed from the top half of the plastic case. Fortunately, there is a groove on the rewind capstan that accommodates the above-mentioned O-rings. Perhaps the manufacturer of the cassette recorders intended to include a digital counter.

Actual final assembly should follow the sequence as shown in Photos 6, 7 and 8. Photo 9 shows the counter enclosed by a home-brew escutcheon made of folded aluminum stock and painted white.

The minimum cost of this modification will be appreciated many times over in time-savings. If a program tape is fully rewound, and the counter zeroed each time at this position, then a reliable index list can be made to an accuracy of one digit on the counter. ■

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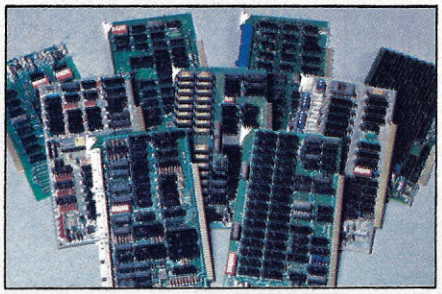
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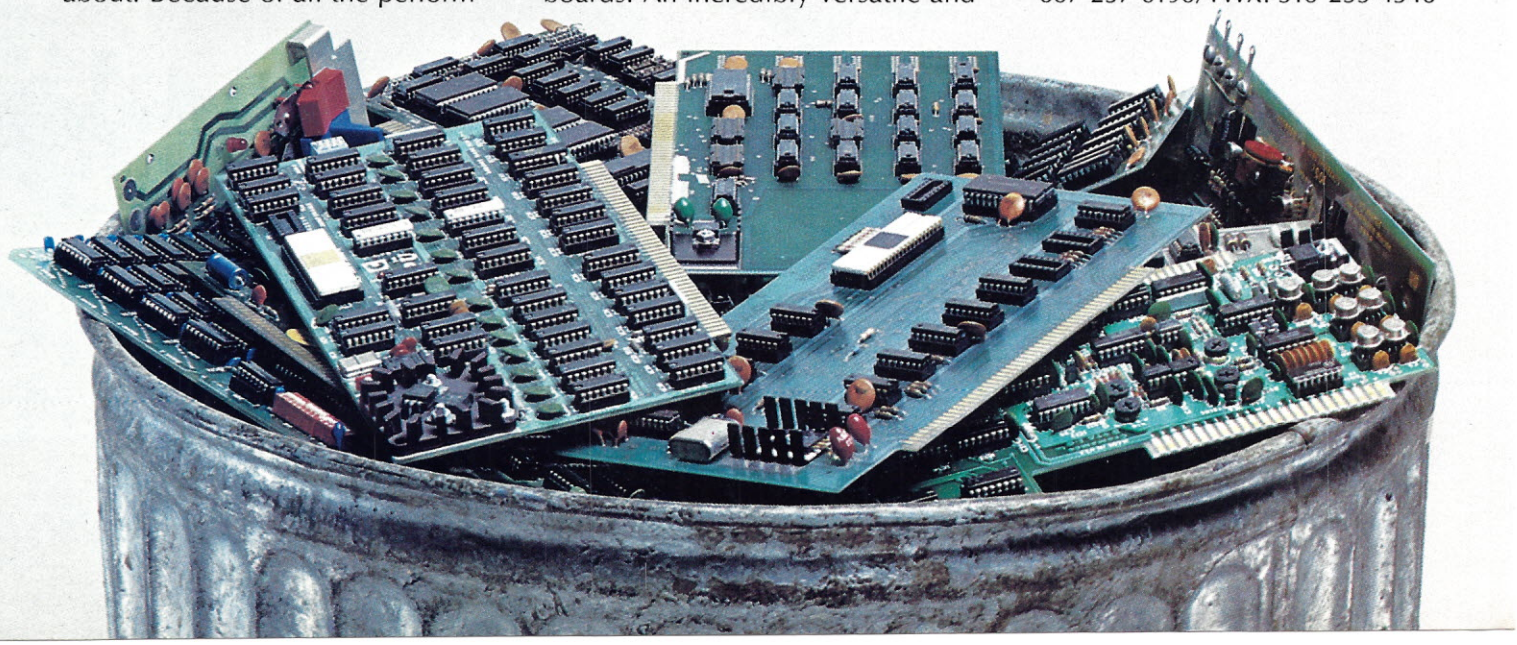
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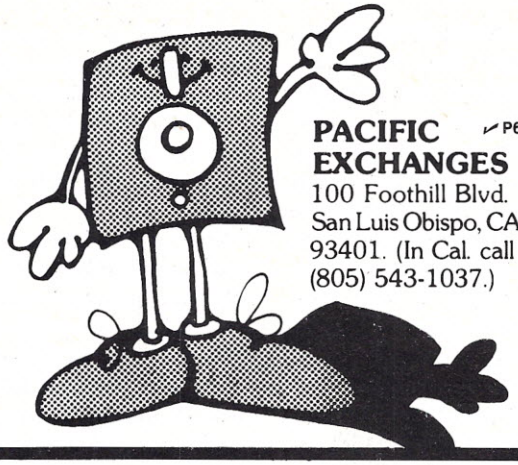
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TSC's Debugger

Is this $39.95 Technical Systems Consultants' package a debugger or a simulator?

Programming in assembly language is an exciting but sometimes frustrating experience. A debugger of some sort is nearly always required. Out of the dozen or so around for the 6800, probably the most common is Motorola's MIKBUG. It is a primitive debugger that will drive you to tears.

Technical Systems Consultants (PO Box 2574, W. Lafayette IN 47906) has made a monumental effort to dry those tears with its SL68-30 package, available for $39.95. A cassette, paper tape or floppy disk containing the object code is also available at a reasonable price. The manual consists of 84 pages of source code and 51 pages on how to use it.

The TSC Package

While TSC chose to call this package a debugger, it is, in fact, a versatile simulator, surrounded by several debugging tools. The simulator has an almost bewildering array of options, sub-options and sub-sub-options.

For example, consider memory protection. Most of us feel fortunate to be able to simply write-protect a page or so of memory, right? The simulator allows you to write protect, but it can also "simulate" protect (run sections of code in real time), "reference" protect (stop references of any kind) and "execute" protect (allow use as a data base, but not as a program) nearly any combination of regions, blocks or bytes in memory.

Breakpoints are also available. Conventionally, a breakpoint will stop a program if it attempts to use the breakpointed address as an instruction. The simulator has eight different breakpoint actions that can be used separately or in combination with each other. You can arrange to simply dump the registers at the breakpoint, zero a states counter, turn the trace mode on or off, increment a histogram counter, print a message, jump to a new address or stop simulation. All of these actions can be conditional on your choice of register contents, memory location values or number of times past the breakpoint. For example, you can arrange to dump the registers the first ten times past the breakpoint, then never again.

Several other features include histograms, state counters and traps. Histograms are counters that are incremented each time a corresponding histogram breakpoint is encountered. This allows you to count the number of times a particular section of code is encountered.

The states counter tallies the number of machine cycles from the last Start or Reset command to the point that simulation was stopped. Since this counter can be zeroed by a breakpoint, it is possible to determine the exact amount of time a particular piece of code takes to run.

A trap is much the same as a breakpoint, except it stops program simulation on an unconditional basis. There are two fixed traps. One catches illegal instruction codes, the other prevents an RTS before a subroutine call is made. The traps that are programmable include a nest count (how many subroutine levels you want to allow), an interrupt trap (stop on any interrupt), a transfer trap (to stop every time a jump or branch is encountered) and a stop trap, which simply stops execution at the assigned address.

Two other commands are particularly noteworthy: the PAST command allows you to automatically disassemble up to 255 instructions executed just prior to whatever stopped the simulator. The TRAIL command prints the address of the last transfer instruction (a jump or branch) and can be used to learn how a program ended up where it did.

I have only touched on the more important commands available. There are many more—too numerous to mention here, but fully explained in the manual.

The debugging tools include the familiar hex dump, with ASCII translations to the right of each line dumped, a hex patch routine much like MIKBUG, a disassembler, a memory fill command, a string search and a line-by-line assembler. This is not a real assembler. It is a patcher that allows you to use assembly mnemonics and conventions rather than hex. It complains nicely when you do dumb things such as try to branch too far, for instance. The disassembler is similar to TSC's disassembler package. The string search can look for a string of either ASCII or hex characters. A decimal-hex calculator is also included. It adds and subtracts decimal and hex numbers interchangeably. Results are printed in both number bases.

There is a price that must be paid for all these goodies. The debugger package needs 8K bytes of core for program and another 1K for variables. It is longer than many BASIC interpreters! And on KC cassettes, it takes a long time to load. Are you writing real-time programs? When the simulator runs in Mode One (full housekeeping and all features), it takes about 250 times longer than real time. Mode Zero, which does away with many features, including memory protection and loop counting, takes only 100 times longer. These times are TSC's figures, not mine.

Comments

The debugger is useful only to those who are programming in assembly language. This would include those writing real-time programs and systems people who are writing compilers, editors and interpreters, or programs not adaptable to high-level languages.

If you are writing real-time programs, the debugger will have little to offer unless the real-time events can be scaled down to the same speed the simulator runs. It may be useful in getting the initial program running, but programs of this nature are generally short enough to be checked out on paper.

This leaves us with the systems people. Is this package useful to you? I believe the answer is a qualified yes. To be really useful, your computer will need disk storage and a substantial amount of core, and your operating system will have to be able to get your object code and the debugger into core simultaneously since no loader is included in the debugger package. (The debugger does include an X command that can pass a command directly to the TSC FLEX operating system.)

The debugger has a plethora of sometimes overlapping commands and options. To be useful, these commands, totaling 51 pages, will have to be committed to memory. Then you must practice them until they are not just memorized, but fully understood. This is a complex system, and you will need a lot of practice before you can use it effectively.

The simulator is probably more useful for large, complex programs than smaller ones. It is particularly effective in chasing down hidden loops and bugs that cause a program to run for a while, then suddenly go berserk.

The manual begins with an informal walk-through of the general operation, then presents the commands in alphabetical order by control function. This makes them hard to look up. For example, where would you look to find the disassembler operating instructions: General System Control, Simulation Control or Memory Commands? If you guessed Memory Commands, you are right! Once you have located the area describing the command, the manual is useful. The commands are described clearly, and several examples always follow.

Did TSC leave anything out? Well, I think that a memory compare and move command should be included in any debugger. Furthermore, it would seem to me that for 8K bytes or so of code, we should be able to load and punch a paper tape or cassette.

Summing up this review, then, I would say that if you need a 6800 simulator, there is now one available. It is slow and will require 9K bytes of core. However, it works as advertised, and it works well. I have not uncovered any bugs so far and have used it to advantage over my old monitor. I expect that as I use this debugger more and more, it will soon become automatic. But until that day arrives, I still have old faithful to fall back on. ■

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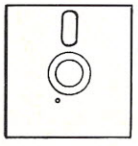
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✓ Reader Service index—page 241

Kid Korner

John Eric Victor, President
Program Design, Inc.
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Greenwich CT 06830

With this program, kids can draw pictures and develop problem-solving skills.

Kids like to draw pictures. It is only natural that the first experience many children have with a computer terminal is making computer pictures. This activity is not only fun, it also has tremendous educational potential.

To draw a computer picture, the computer artist must first analyze the image and break it down into its component parts of lines, curves, shades, etc. Then these components must be translated into the images, such as ASCII characters or small graphic spots on a video screen, the computer terminal can make. This type of problem-solving skill, the ability to break tasks down into component parts, is one of the intellectual foundations of computer programming.

Computer art is an excellent way to introduce a potential programmer to the world of computers. It is something like a glorified jigsaw puzzle. If we use a BASIC program to generate a picture, then each line of the program becomes a different piece of the puzzle.

What I am proposing in this *Kid Korner* is a game that will develop both problem-solving skills and the ability to mentally fill in incomplete pictures (which is another component of intelligence). I call it the computer jigsaw-puzzle game. One player "draws" a picture on a computer video terminal and then removes it from the screen. A second player then tries to guess what the picture is by calling up "pieces" of the puzzle on the screen.

The program listing is written in Apple BASIC for the Apple II computer. As with past *Kid Korner* articles, I have tried to avoid any programming techniques unique to the Apple system, so that this program can be easily modified to run in any BASIC supporting string variables and logic. I was able to run this program in less than 4K of RAM on the Apple. The Apple II video display is 40 characters by 24 lines. Those readers with 16-line video displays must remove

```
10 REM COMPUTER JIGSAW PUZZLE IN APPLE BASIC
20 REM BY JOHN ERIC VICTOR
22 DIM A(20): REM ONE MEMBER OF THE ARRAY FOR EACH LINE IN PUZZLE
23 FOR X= 1 TO 20: A(X)= 0: NEXT X
30 REM SET STRING VARIABLES FOR EACH LINE IN PUZZLE
31 DIM A$(40), B$(40), C$(40), D$(40), E$(40), F$(40), G$(40)
32 DIM H$(40), I$(40), J$(40), K$(40), L$(40), M$(40), N$(40)
33 DIM O$(40), P$(40), Q$(40), R$(40), S$(40), T$(40)
40 REM VARIABLES FOR NAME OF PIC
41 DIM W$(20), Z$(20)
45 PRINT
50 PRINT: PRINT "THIS IS THE GAME OF COMPUTER JIGSAW."
60 PRINT "IT IS PLAYED BETWEEN TWO PLAYERS."
65 PRINT "ONE PLAYER DRAWS A PICTURE, AND THE"
68 PRINT "SECOND TRIES TO GUESS WHAT IT IS BY"
70 PRINT "LOOKING AT PARTS OF THE PICTURE.": PRINT: PRINT: PRINT
75 PRINT "FIRST PLAYER, DRAW YOUR PICTURE--"
77 PRINT "(SECOND PLAYER, DON'T LOOK!)": PRINT
80 INPUT A$, B$, C$, D$, E$, F$, G$, H$, I$, J$
81 INPUT K$, L$, M$, N$, O$, P$, Q$, R$, S$, T$
85 INPUT "WHAT IS THE NAME OF YOUR PICTURE?",W$
90 PRINT: PRINT "NOW WE CLEAR THE SCREEN..."
95 FOR X= 1 TO 1000: NEXT X: FOR X= 1 TO 23:PRINT: NEXT X
100 PRINT "PLAYER 2, WHAT LINE OF THE PICTURE"
101 INPUT "DO YOU WANT TO SEE",Y
105 IF Y>20 OR Y<=0 THEN 100
108 A(Y)= 1: N= N+1
120 REM IF ARRAY NUM.= 1 THEN PUZZLE PART PRINTED
121 IF A(1)>0 THEN PRINT A$: GOSUB 500
130 IF A(2)>0 THEN PRINT B$: GOSUB 500
140 IF A(3)>0 THEN PRINT C$: GOSUB 500
150 IF A(4)>0 THEN PRINT D$: GOSUB 500
160 IF A(5)>0 THEN PRINT E$: GOSUB 500
170 IF A(6)>0 THEN PRINT F$: GOSUB 500
180 IF A(7)>0 THEN PRINT G$: GOSUB 500
190 IF A(8)>0 THEN PRINT H$: GOSUB 500
200 IF A(9)>0 THEN PRINT I$: GOSUB 500
210 IF A(10)>0 THEN PRINT J$: GOSUB 500
220 IF A(11)>0 THEN PRINT K$: GOSUB 500
230 IF A(12)>0 THEN PRINT L$: GOSUB 500
240 IF A(13)>0 THEN PRINT M$: GOSUB 500
250 IF A(14)>0 THEN PRINT N$: GOSUB 500
260 IF A(15)>0 THEN PRINT O$: GOSUB 500
270 IF A(16)>0 THEN PRINT P$: GOSUB 500
280 IF A(17)>0 THEN PRINT Q$: GOSUB 500
290 IF A(18)>0 THEN PRINT R$: GOSUB 500
300 IF A(19)>0 THEN PRINT S$: GOSUB 500
310 IF A(20)>0 THEN PRINT T$: GOSUB 500
315 PRINT: INPUT "WHAT DO YOU THINK THE PICTURE IS?",Z$
330 IF Z$= W$ THEN 2000
335 IF N= 20 THEN 1000
340 PRINT "TRY AGAIN...": GOTO 100
500 IF A(Y)= 0 THEN PRINT: RETURN: REM LEAVES BLANK LINE
1000 PRINT "THAT WAS ";N;" TRIES.  HERE IS WHAT THE PICTURE WAS:": GOTO 2010
2000 PRINT "CORRECT!  YOU GUESSED IT IN ";N;" TRIES."
2005 INPUT "PUSH RETURN TO SEE THE WHOLE PICTURE",X$
2010 PRINT A$: PRINT B$: PRINT C$: PRINT D$: PRINT E$
2020 PRINT F$: PRINT G$: PRINT H$: PRINT I$: PRINT J$
2030 PRINT K$: PRINT L$: PRINT M$: PRINT N$: PRINT O$
2040 PRINT P$: PRINT Q$: PRINT R$: PRINT S$: PRINT T$
2050 PRINT
2060 PRINT W$,"NUMBER OF TRIES: ";N
5000 END
```

Program listing.

some lines from the puzzle.

In the first part of the program one player enters a picture on the screen a line at a time using ASCII characters (see first photo in series). (A younger child will have an easier time with this part of the program if he or she first makes the picture on graph paper.) After the player finishes the picture, he or she then types in the name of the picture and clears the screen. In order to keep arguments from arising concerning the name of the picture, a list of possible pictures can be drawn up before starting. The name of the picture then must appear on that list.

The second player now tries to guess what the picture is. He or she types in a picture line number (from 1 to 20), which then appears on the screen along with previously called line numbers. The player then tries to guess the picture. If the guess is correct, the program shows the complete picture and how many guesses the player took to identify it. The second player is allowed 20 tries.

The program itself is clear-cut. Each line of the picture is stored in a separate string variable. Since the Apple uses a 40-character line, each string variable is dimensioned to 40 characters. Line 90 is used to clear the screen after the picture is entered, but it can be replaced by a screen clear instruction (on the Apple II this is CALL-936).

Line 23 sets up a single-dimension array that contains a "flag" for each line of the puzzle. For example, if a player calls for picture line 3, line 108 in the program sets A(3) equal to 1. Now each time the program loops through lines 120 to 315, line 3 of the picture will appear. A blank line appears for each line of the picture that has not been called for by the player.

The Apple II as a Teaching Machine

Writing this program gave me an opportunity to use an Apple II computer. My first impression of the Apple II (before I had a chance to use one) was that it was a "gee-whiz" fun-and-games system that probably wasn't worth the extra cost when compared to similar appliance computers such as PET or the TRS-80. (Appliance computers are those systems with computer and keyboard integrated into one unit with the BASIC interpreter in read only memory.) However, after having used one, I have had a 180-degree change in opinion. Most of the fun-and-games features of the Apple II have significant educational applications.

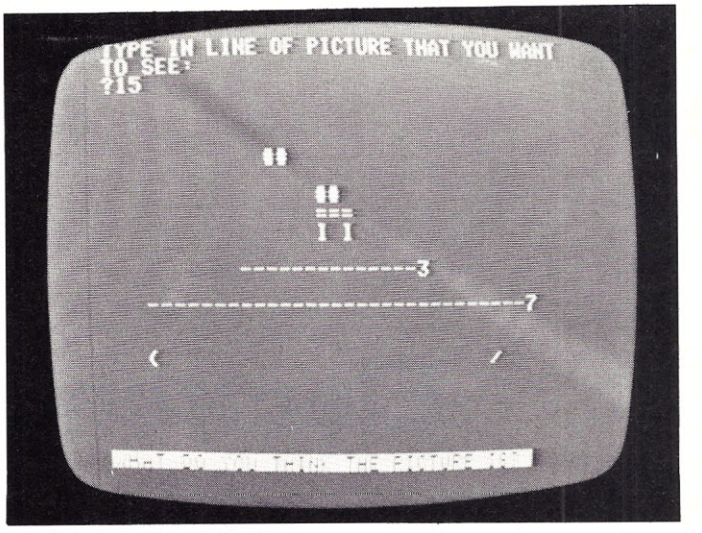
One of the distinguishing features of the Apple II is the color-graphics capability. For young children this can be important not only for motivation and interest but also for the learning process. For example, a child can be taught to recognize the letter t, but when the color of the letter is changed, the child may not recognize the resulting figure as being the same letter t. The use of color can significantly improve a child's discrimination ability.

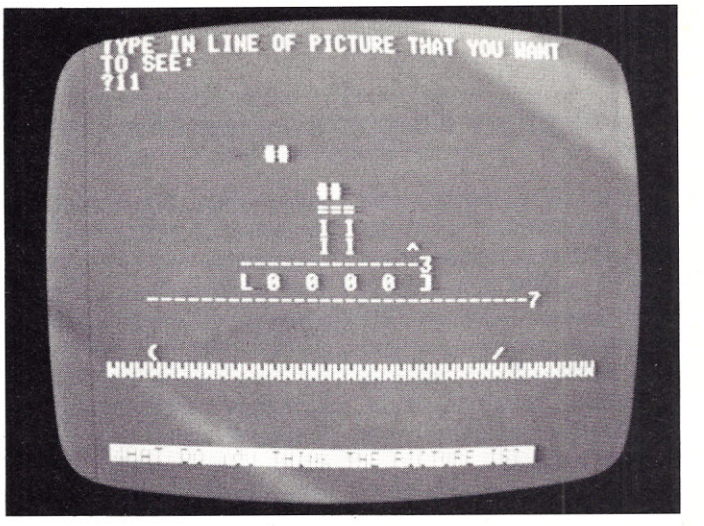
Another feature is sound generation. Apple II recognizes a bell character and has the ability to generate a whole range of sounds and musical notes. The more strongly a point (or reward) can be made in an educational program or game, the more likely learning is going to take place. Backing up visual information with sound is one way to strengthen the learning process. Sound can also be used to focus the program user's attention to something happening on the video screen (as in pong-type games where hitting or missing the blip produces characteristic sounds). The Apple II sound system can also be used to teach music theory.

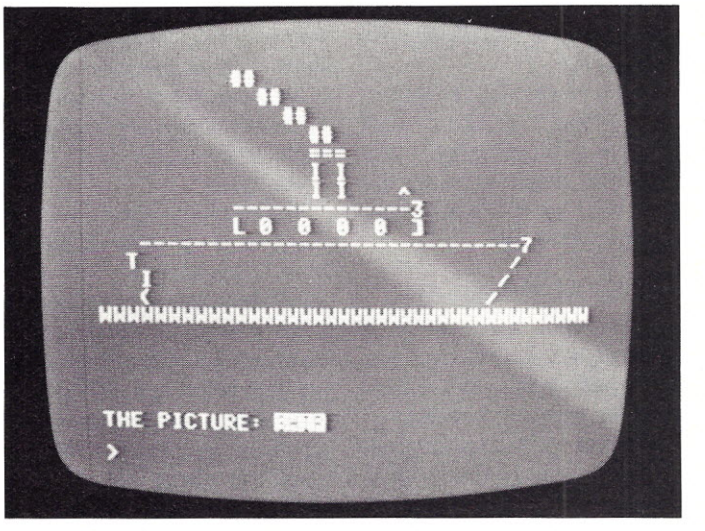
A third feature is that the BASIC allows for direct keyboard entry of responses, bypassing the RETURN key. This means that the program can respond much more quickly to a child's inputs. It also means that inputs can be simplified for young children by elimimating the need for hitting the RETURN key after each input.

A fourth feature is the ability to input in BASIC from two game paddles. From an educational standpoint, this allows the programmer to write games and simulations involving more than one participant. The game paddles can also save some wear and tear on the keyboard.

As teaching devices, the latest generation of appliance computers offers substantial improvements over Teletype terminal systems because of its speed, print formatting and graphics capabilities. The Apple II opens up even more possibilities.■







Shipbuilding on the screen.

Kirk A. Godfrey-Kerekes
1509 S. Elwood
Tulsa OK 74119

Electronic Systems' Modem Kit

You might try using this inexpensive modem kit in conjunction with "dialing up" (see p. 48).

At $27.50 for the complete kit, or $7.60 for the bare circuit board, the Electronic Systems (Box 21638, San Jose CA 95151) Modem Kit is certainly the least expensive route that I know of for tying your computer to the phone lines. It is, in fact, less than one third the cost of its nearest competitor.

Frankly, the low cost worried me when I ordered the kit. If it worked, it would be a steal; but $27.50 for an electronic lemon is no bargain.

And so I was not unduly surprised when it refused to work properly after assembly. I *was* surprised, however, with the ease with which its problems could be corrected!

MODulation, DEModulation

Let's define some terms. A modem is a device that converts the digital signals from a computer or terminal to bursts of tones that are suited to transmission over common telephone lines. The modem can also detect the tones sent by another modem and convert them back to digital signals that a terminal or computer can cope with. These days, modems may also have the ability to automatically dial and/or receive calls and may be compatible with several different standards.

A *full duplex* modem is one that can transmit and receive simultaneously. This requires different sets of tones for transmit and receive, and also requires that one modem's transmit tones be the same as the other's receive tones. The standard response to these requirements is to separate modems into two functional groups: *originate* modems, which transmit low-band tones (see Table 1), receive high-band tones and generally originate the call, and *answer* modems, which transmit high tones and receive low tones. Most professional modems may be switched from one type to the other; sometimes the switching is automatic.

The most common modem for use over unconditioned phone lines is the Bell 103 type. The data rate is kept at or below 300 baud (about 30 character(s)), which minimizes problems arising from group delay, noise and the generally unpredictable quality of voice-grade phone circuits. The official Bell 103 standards are summarized in Table 1.

Data rate:	300 baud or less
Frequency, transmit:	1270 Hz (logic 1), 1070 Hz (logic 0) "low band"
Frequency, receive:	2225 Hz (logic 1), 2025 Hz (logic 0) "High band"
Output level:	Nominally, 13 dB below average voice levels
Data format:	No official standard, but the de facto data format statement is 1 start bit, 8 data bits and 1 stop bit. No parity. This is compatible with the Kansas City Standard format, so that any serial port currently driving a KC cassette unit should be compatible with most other systems if used with the modem.

Table 1. Basic Bell 103 specifications.

The Electronic Systems Circuit

The ES Modem is based on two ICs: the XR-2211 (Exar), used for receive tone detection, and the LM 567, used to generate the transmit tones (see Fig. 1). The 2211 is designed with just this sort of application in mind, and its use is the dominant reason behind the low cost of the modem. As supplied, the modem is intended for originate mode only; however, a few part changes (Table 2) can convert it to answer mode. In either mode, it is full duplex, Bell 103 compatible.

Part	*New Value*
C3	.039 uF
C6	.01 uF
C7	.001 uF
C8, C12	REMOVE
R4	100K

Table 2. Component changes for answer modem.

The Electronic Systems kit (part #109) consists of a 2¼-inch square circuit card, a bag of parts and an assembly/calibration flyer. With my flyer also came an errata sheet bearing a revised schematic, pictorial and parts list.

Assembly is simple and to the point; there were no defects on the circuit card, and the layout was not crowded, despite the small board size. Sockets are provided for the three ICs, and there is no ambiguity as to parts placement.

The instruction flyer is well written and organized and does not contain any annoying omissions. A theory of modems and a theory of this device are included. The instructions for assembly are not the step-by-step Heathkit type, but they are quite adequate.

Calibration requires at least a fairly accurate function generator capable of delivering the Bell 103 tones, which are bounded by 1070 and 2225 Hz. The transmit and receive frequencies are adjusted by two one-turn trimmers, and the two adjustments do not interact. The transmit tones (R9) may be set by ear if small speakers are connected to

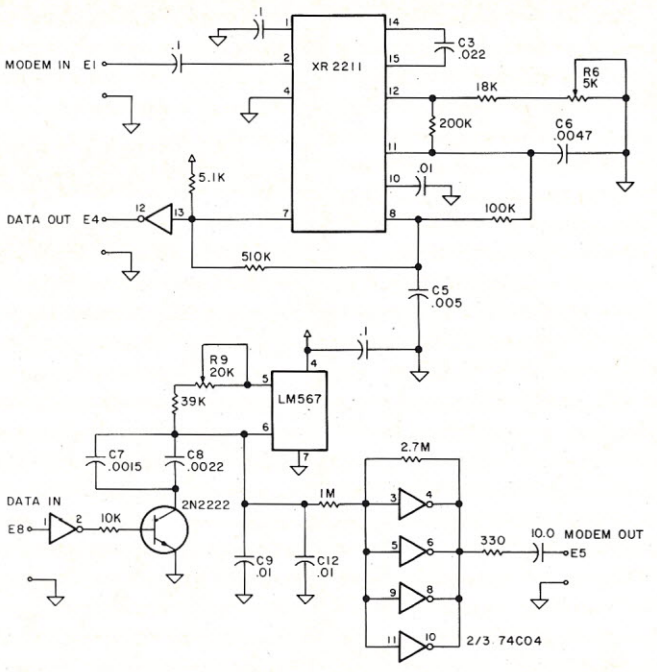


Fig. 1. Original Electronic Systems circuit.

the outputs of both the function generator and the modem. The receive adjustment (R6) requires some method of detecting a state change at the modem's data output: a voltmeter, oscilloscope or even an I/O port with a simple program to constantly verify the status of the port.

Drifting Caps

You might have some difficulties with the receive adjustment, and for good reason. With the parts supplied, it drifts badly. The culprit is C3, the capacitor that sets the center frequency of the receive detector's phase-lock loop.

In my kit, the .022 ceramic capacitor specified in the parts list had been replaced by two .01 uF ceramics, which I dutifully installed. When I couldn't get the receive threshold to stay put for more than a few minutes at a time, I dug up an Exar data book and looked up the XR-2211 used in the modem. There I found the same circuit as the receive portion of the modem, right down to the parts' values. From the manual, I gleaned two important bits of information: that Electronic Systems had specified imprecise, drift-prone ceramic caps in a number of places that they didn't belong, and that they hadn't made full use of the XR-2211's capabilities.

After scouring my parts drawers, I found Mylar and poly caps sufficient to replace all of the ceramics. Suddenly, the receive detector stopped drifting, and I began to have some genuine hopes of getting a useful device out of all this.

Carrier Detect

I then added a useful feature that the modem's designer had failed to include. Implicit in the XR-2211 chip is a carrier-detect subsystem consisting of an open-collector type output that switches to ground whenever there is not a good carrier present. The circuitry required for this option is minimal and easily tacked onto the Electronic Systems board. Fig. 2 shows the additional parts needed to implement the carrier detect.

When in place, the carrier-detect system ensures that output "trash" is kept to a minimum by disabling the data output when a good carrier is not present. Without the carrier detect, the modem puts out an intermittent stream of ones and zeros as it tries valiantly to lock onto any and all input noise.

The carrier-detect output at pin five, which complements pin six, may be used with serial ports that support a separate carrier-detect input, such as the MC6850 used in my OSI C2-8P. Like pin six, it is an open collector and thus requires a pull-up resistor.

The Final Solution

Unfortunately, even with all these improvements, the modem most likely will still not work when coupled to a real phone line. The difficulty is that the transmit tones totally overwhelm the receive detector's input, rendering it incapable of responding to the much fainter high-band tones coming from the modem at the other end of the phone line. This is true whether you use Electronic System's acoustic coupler method or their transformer technique.

After experimenting with active filters and similar approaches, I settled on an effective and simple method (Fig. 3). With the addition of two trimpots, a resistor and an inexpensive, junk box audio transformer, the problem is solved. The effect of the circuit is to cancel out virtually all of the low-band output at the modem's input while not interfering with high-band input. To adjust, connect the output of the transformer to the red and green wires of a standard, single-line telephone. The telephone should not be connected to the phone lines. Also connect a 600 Ohm (560 will do) resistor across the output of the transformer.

The resistor and the telephone provide a fair simulation of an active phone line, at least as far as the modem is concerned. Take the phone off the hook and listen as you adjust R13. The low-band tone should be at a level that is comfortable to listen to over the phone, but loud enough that there is no doubt as to its presence.

R14 is adjusted with the aid of a crystal earphone, audio signal tracer or oscilloscope. Whatever you happen to be using, attach it to the input (E1) of the modem and adjust R14 for the minimum amount of low-band tone. In my system, the tone nulls out virtually 100 percent.

Assuming your frequency standards are accurate, this is the last adjustment you should need to make. To interconnect with the phone line itself, I recommend the use of a tandem coupler (Radio Shack #279-369 for standard phone sets or 279-357 for modular phone sets), which allows connection of both the telephone and the modem at the same time.

The phone line interface may be left connected at all times, as the output capacitor's dc blocking and low frequency impedance make it invisible to telephone equipment. In fact, you must leave your phone off the hook in order to use the modem. This allows easy monitoring of the line during use and seems to cause no problems.

For convenience, I suggest that you place a switch or relay, in parallel with the output capacitor. A fast enough relay, driven by an I/O port, can be

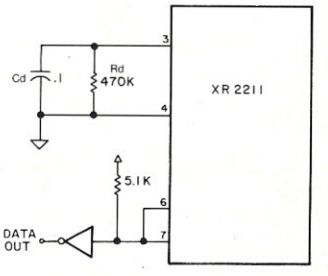


Fig. 2. This figure shows the carrier-detect option. Pins 6 and 7 are jumpered together, and C(D) and R(D) are added to the option.

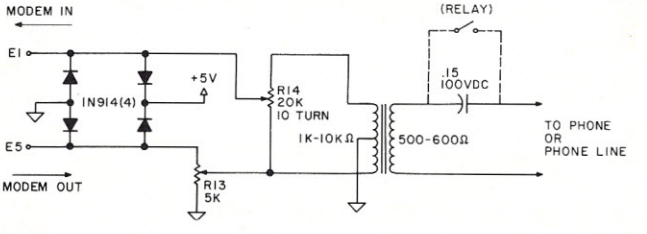


Fig. 3. Output interface. Transformer is miniature audio type. 1N914 diodes clamp any voltage spikes that might make it through to the modem.

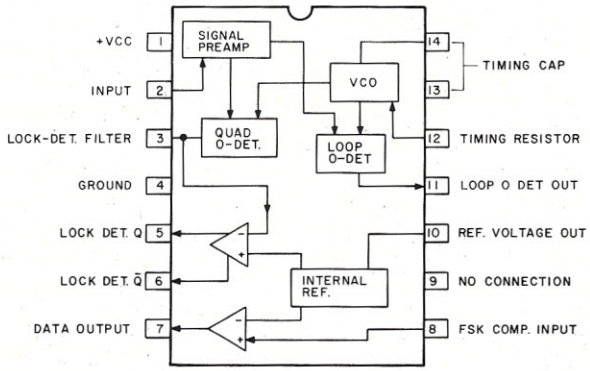


Fig. 4. XR-2211 block diagram.

used for automatic dial-up—a feature found normally only on quite expensive devices.

You may wish to final-trim the last two adjustments after finally installing the modem at the phone line, but it will probably not be necessary.

Final Thoughts

In my research for this article, I found that you can purchase the parts to populate the Electronics Systems Modem for about $22, including the purchase of the empty circuit card from ES. It is, of course, much more convenient to purchase the complete kit as a unit, even if you do throw away and replace four of the capacitors.

Were I to do it again, I would probably buy the parts separately and put the $5.50 difference toward packaging the unit up nicely. I would also try to get polystyrene caps for all of the critical values, i.e., C3, C5, C6, C7, C8, C9 and C12. While I have had no stability problems with the modem since I got rid of the ceramics, it never hurts to indulge in a little overkill on the quality of critical components.

After the modifications, the Electronic Systems Modem works remarkably well. I have used it to ring up every local telephone-accessible system I know, and it has performed admirably. If you can find another hobbyist in your area who has a 103-type modem, you will be set for much convenient program exchange, long-distance game-playing and other similar activities. Even if you pay for local calls by message units, they are still less expensive (and faster) than burning $1 a gallon gas! It's probably cheaper than mailing a cassette (not even counting the cost of the cassette), and it is certainly more fun.

Low-cost modems such as this one make local "electronic bulletin boards" much more practical for computer clubs or dealers. And, of course, if you have the proper access codes and a terminal or terminal-simulator program for your computer, you can access the large time-sharing systems. For $27.50, a modem may turn out to be the most useful and entertaining peripheral bargain available to the computer hobbyist. ■

An Aside on Telephone Interconnection

There are two basic ways to interconnect the modem to the phone line: electronic and acoustic. Electronic coupling has multiple advantages unless frequent portability is required. Direct connection to the telephone lines is, of course, covered by local tariffs as well as recent FCC decisions. Use care. I do not cover acoustic coupling in this article, as it materially increases the cost and complexity of the project, defeating the point of a low-cost device. In the case of multiple-line phones or a strong personal desire to avoid tinkering with phone lines, the modem leads may be clipped to the wires going to the *receiver* in the handset. If you own your own phone, you can even install a jack to make interconnection easier.

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✓ Reader Service index—page 241

Tom Crawford
50 Brentwood Dr.
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Canada L8G 2W8

Tiny BASIC Square Root Routine

Story on how this author got squared away with Tiny BASIC.

Recently I spent three long evenings keying Tom Pittman's Tiny BASIC into my 1802 system. After making several copies on cassette tape, I prepared to bring Tiny to life. Amazingly, it worked the first time. Several short programs served to satisfy me that Tiny BASIC was fully operational. (The first program was a counting and printing loop—with no termination! It provided a good test of the BREAK key on my keyboard.)

It was time to get down to serious business. I began searching all the BASIC games books I had accumulated, looking for demonstration programs I could run. Remember, Tiny lacks floating point numbers, character manipulation, SQR( ), data statements, dimension statements and a few other things.

This weeded out quite a few programs I would have liked to try, but I still managed to fill several cassettes with games such as Tic-Tac-Toe, Acey-Ducey, Moon-Lander . . . but wait, I didn't notice the use of the SQR( ) function in Moon-Lander until I was three-quarters of the way through "hunt and pecking" it into my system. I wasn't about to waste all that effort, so obviously the only thing to do was to write a square root routine, right?

The Routine

At this point my old four-function calculator proved useful again. The hardware had long since disappeared into various projects, but the instruction manual was still around and contained an elegant little algorithm for finding square roots. All that I had to do was program this into a little subroutine.

The algorithm is shown in Example 1, where x is the number we wish to find the square root of, and Y is an approximate square root. We simply code this into a loop and go around the loop until $(Y_{n+1} - Y_n)$ is less than the error we are willing to accept. Since Tiny BASIC works in Integer, it is acceptable to use $Y_{n+1} = Y_n$ to terminate the loop.

The only other thing we need before we can code this is the initial estimate of Y, Y_1. The closer Y_1 is to the final value of Y, the faster the square root function will work. Although using Y = a constant (say 100) will work, I chose to use a straight-line approximation of the root

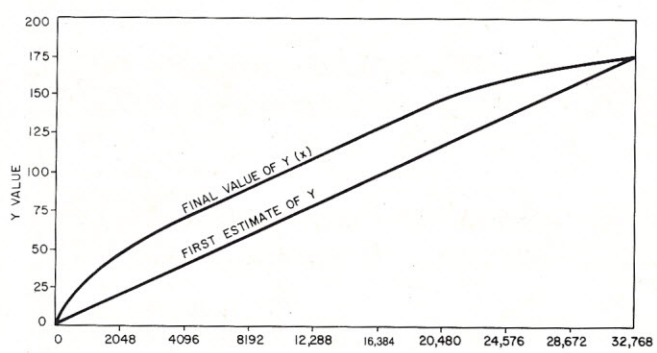


Fig. 1. Tiny BASIC Square Root routine. Root of $x = Y_{n+1} = Y_n/2 + x/(2*Y_n)$, where the first estimate of $Y = x/182 + 2$.

$$Y_{n+1} = 1/2\left(Y_n + \frac{x}{Y_n}\right)$$

Example 1.

$$Y_1 = \frac{x}{182} + 2$$

Example 2.

```
1000  REM       SQUARE ROOT ROUTINE.  RETURNS ROOT OF A IN
1010  REM       B. WORKSPACE IS C.
1020  IF A>1 GOTO 1050
1030  B=1
1040  RETURN
1050  B=A/182+2
1060  C=(B+A/B)/2
1070  IF B=C RETURN
1080  B=C
1090  GOTO 1060
```

Example 3.

```
1000  REM       SQUARE ROOT ROUTINE.  RETURNS ROOT OF A IN
1010  REM       B. WORKSPACE IS C AND D.
1020  IF A>1 GOTO 1050
1030  B=1
1040  RETURN
1050  B=A/182+2
1060  D=0
1070  C=(B+A/B)/2
1074  REM CHECK IF C SHOULD BE ROUNDED UP
1075  IF (A-A/(2*B)*B*2)>B C=C+1
1080  IF B=C RETURN
1085  REM CHECK FOR OSCILLATION OF RESULT
1090  IF (B-C)=D GOTO 1130
1100  D=C-B
1110  B=C
1120  GOTO 1070
1130  REM PICK THE LARGER OF B OR C THEN RETURN
1140  IF B>C RETURN
1150  B=C
1160  RETURN
```

Example 4.

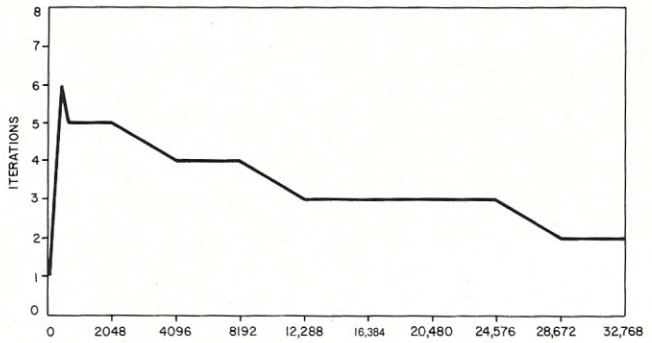


Fig. 2. Number of iterations of the algorithm required over the range 0<x≤32,7676.

(see Example 2).

The term 2 prevents Y_n from becoming 0, which will result in a divide by 0 error in the first equation. The factor 182 results from consideration of the useful range of the routine, and is approximately $\sqrt{32,767}$ (see Fig. 1).

Note that this routine will not handle $\sqrt{1}$, but this can be tested for and handled separately. Thus the effective range of the square root routine will be: $1 \leqslant x \leqslant 32,767$.

At this point the routine was coded up and used in Moon-Lander with no apparent problem. The routine is shown in Example 3.

Modification

Unfortunately, there are still two problems with this routine. First, for some values of A, such as 8, the condition B = C is never satisfied. The value of B in the case of A = 8 will oscillate between 2 and 3. This is caused by the truncation error in line 1060 of Example 3, where C is calculated. It is necessary to modify the routine to watch for this situation, pick one of the two values as the root and then return.

The second problem is that this routine does not return the correct root for many of the "perfect square" numbers, such as 16 and 64! It will be necessary to correct for this truncation by rounding up the result C if the remainder exceeds .5. It is sufficient to check the remainder of the second term only in line 1060.

The modified routine is shown in Example 4. Fig. 2 gives some indication of the speed of the algorithm for various input values. ■

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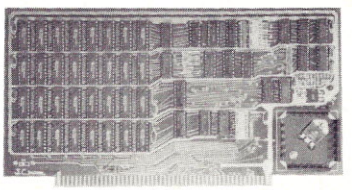
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✓ Reader Service index—page 241

Documentation: A Closer Look

The term "documentation," like many others in computing, is used indiscriminately. Here's what it means and what documentation includes.

Patrick C. Moyer
40 Stuyvesant Manor
Geneseo NY 14454

The word documentation is used loosely in personal computing circles. Taken in context, it can mean anything from a printed listing of a program to the addition of a few remark lines in the body of the program to a written description of the operation and structure of a program or system. What does documentation really mean? What should documentation include?

Generally, documentation is any written information that adds to a person's ability to understand the program/programs. Documentation comes in two basic forms: internal, which is information presented within the confines of the program listing or printout/screen display, and external, which is a printed document written in English (i.e., in sentences and paragraphs) and accompanies the program.

We cannot stop here, however. There are two types of documentation: user documentation and system documentation. User documentation is a nontechnical guide to the use of the program or programs. System documentation, on the other hand, is meant for the programmer whose job is to update, maintain or modify the program. System documentation assumes a certain level of computer literacy, user documentation almost none.

Each of these groups interfaces in different ways with both the program and the machine. Each of these groups needs a different combination of internal and external information to satisfy its individual needs.

In the infancy of personal computing (which is fading faster everyday), the user and the programmer were one and the same. The personal computerist was technician, programmer and user. Thus, the distinction between the nontechnical user and the programmer was very fuzzy. As more and more users entered the picture, it became necessary to make this distinction clearer. Let's examine the difference between these groups and their unique needs for documentation.

User Documentation

A computer user is a person who sees the machine as a tool, a means to an end in his job, or as an entertainment unit that works and works well. He is interested in how easily and inexpensively he can achieve his purpose. The user is usually well versed in the application and its jargon, but is not a programmer or a systems analyst. Thus, user documentation must use the language that is common within that particular field.

The first item that should be included in a user documentation is an introduction to the program. This should contain some brief background as to why the program was written and a little about why this program is a unique or extraordinary application. Be to the point and factual.

The user next expects (and deserves) step-by-step instructions on the use of the program. The writer of user documentation has to assume that his reader has only a limited knowledge of the computer he is working with, and even the most elementary buzzwords should be avoided whenever possible. If they are used, they should be explained precisely and simply. It is always better to be too simple than too complex.

If the reader is familiar with the information, he can easily skip a particular section that is too elementary. On the other hand, if a user is overwhelmed by the language, he will become discouraged and will never have the benefits of the program. It is a good idea to try directions out on a co-worker or a family member, because as always, "You may think you know what you thought you said . . . ."

Next, you should include a full explanation of all inputs and outputs. Even if the printout or screen display explains them in detail, explain them again in print. Explain what inputs are needed. A simple game program may just need a name or a few instructions. The user may want to use them while he is learning the game. For more complex applications, the need is greater. For example, what are the maximum number of entries allowed in an inventory program? What are the restrictions on the size of names and addresses on a mailing list program?

Basically, write what information the user must supply to achieve the results he wants. Many users think the machine can handle any situation and produce magical results with little input. Unfortunately, this is a common misconception among first-time computer users.

Indicate whether the program requires that information be in a specific format or if a particular format will make entering the information easier. This can save the user many errors and much time.

A sample of all output should be included, whether this be hard copy, printed output or just a screen display. You should explain this sample as precisely as possible. The user needs only to review the sample to gain insight. Remember that in most cases the only link with the user is the documentation. Antici-

pate his questions.

The documentation should always include a listing of the program or system's requirements in regard to hardware, software and personnel. Is a certain operating system necessary in order to run the program? Is it assumed the user has a certain subroutine or function available to him? What hardware is needed to use the program: 4K, 16K, 48K, a printer, dual disk drives?

Be realistic about memory and hardware. The world's most efficient mailing list program may run on 16K, but if it will only handle 100 names it is going to have very limited use. But if it will run better and more reasonably using 48K and dual disks, say so. If it is that good, the equipment will be no problem.

Will the user have to have special skills? Can it be used by an unskilled employee, or does the user have to be a CPA? Does the user have to be an expert chess player, a poker wizard or a Star Trek fanatic just to use and understand this program? Is the educational program meant for college students or first-graders? Be aware of the user, his abilities and limitations.

Always include an estimate of the run time and cost of operating the program. Will it take 100 hours or one hour to enter and print 1000 names into the mailing list program? Does it take an hour or two minutes to play a game or execute a simulation with the program? If it is a business activity, how much will it cost both in terms of computer and personnel time and effort.

A good user documentation should, then, contain at least the following elements: an introduction, step-by-step user instructions, a set of input/output specifications, program requirements and cost/run estimates. It is also helpful to insert any other relevant information or outside references that might aid the user in efficiently using this program or system of programs. If you use certain formulas or techniques that would be of interest or importance to the user, place them here. To help in writing user documentation see the outline in Example 1.

I. INTRODUCTION
   a short description of the purpose and function of the program
II. STEP-BY-STEP USER INSTRUCTIONS
   a guide to using the program
III. INPUT/OUTPUT SPECIFICATIONS
   a description of all needed input and all produced outputs
IV. PROGRAM REQUIREMENTS
   a listing of all needed hardware, software and personnel needed for program operation
V. COST/RUN TIME ESTIMATES
   a listing of time and, if applicable, cost of running program
ADDENDUM
   other necessary information needed by user, e.g., formulas used in program calculations

Example 1. User documentation outline.

System Documentation

Systems documentation, on the other hand, is written for the systems analyst or programmer who finds it necessary to change or modify the program. He needs a technical description of the structure of the program. He needs to gain access to the internal functioning of the program as efficiently as possible.

The first component of the documentation should be a copy of the user documentation. It is imperative that the programmer or analyst understand how the program is supposed to work so he can modify or update it. However, there are a number of additional items that should be included.

It is necessary to have a written description, in English, of how the program actually functions, that is, a step-by-step commentary on the operation and content of the program. It is a good idea to coordinate it with the next major component of the system documentation, the program listing. A useful technique is to key the description to particular sets of line numbers. For example, list a starting and ending line number, and in print beside it, discuss the purpose and function of these statement lines.

As mentioned above, the next major addition necessary to the system documentation is an accurate and dated program listing. Computer programs are often changed, thus it is always necessary to have a copy and date of the very latest listing of the program so that it can be easily referenced. The program listing should also contain sufficient comment/remark lines to be as self-explanatory as possible. Remark lines are an integral part of the program and need to be treated with the same importance as all other "necessary" statements.

The documentation should include a variable reference table, which lists all the variable names that are used in the program. In addition, this table contains what the variable stands for or is used for during the program. Also included is any additional pertinent information about the variable, such as usage (i.e., integer, string, etc.), limits or restrictions.

It can also be instructive to offer any supplemental information that might be useful to the person who works on the program. It may be helpful to add any ideas for possible expansion or modification. Be specific in the suggested modifications, including before and after line listings.

A flowchart is another necessary item for good documentation. A good flowchart can be as indispensable as a good circuit diagram is to an electronics technician. It is easier to use a flowcharting template with standard symbols, but it can be drawn freehand.

Most introductory programming texts include a section on flowcharting, which can be used as a guide. Drawing a flowchart of the program can be a tedious, time-consuming task, but it is worth it in the long run.

Summary

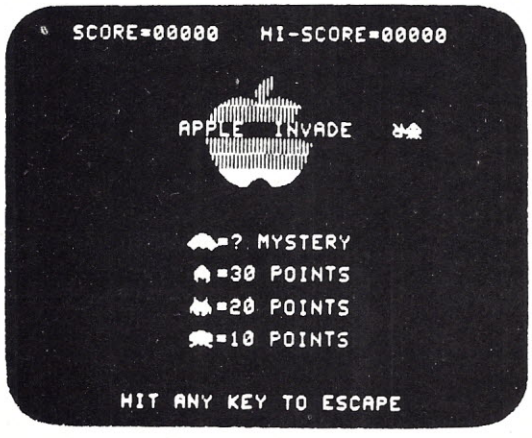
A system documentation contains the following: a copy of the user documentation; a narrative of the program operation; a printed listing of the program, including remarks; variable reference table; supplemental information; and a flowchart. Example 2 is an outline that may be useful in preparing system documentation.

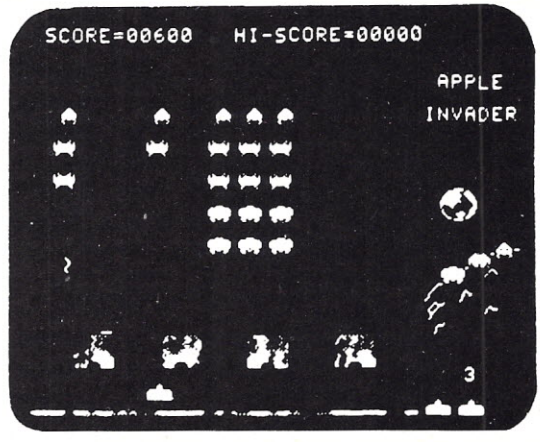
The initial cost to the programmer in time and effort to create a good set of program documentation is substantial. The end result, however, is worth it. A program or set of programs is of no use to anyone if it cannot be used to its fullest, or modified in a changing situation. This is also true of the purely personal program written only for the enjoyment of the programmer. Many good programs are going to waste because either the programmer forgets he has the program, or has forgotten how to use it and finds it easier to write a new one rather than figure out the old. The habit of preparing complete documentation, once started, becomes automatic as well as rewarding. ■

I. USER DOCUMENTATION
   a copy of the user documentation is enclosed here
II. PROGRAM NARRATIVE
   a written commentary on the program's operation
III. PROGRAM LISTING
   a printed, internally documented program listing
IV. VARIABLE REFERENCE TABLE
   a table listing variables and information about them
V. SUPPLEMENTAL DATA
   information on modification or extension of programs
VI. A FLOWCHART
   a complete flowchart of the program
ADDENDUM
   any additional information which may be of help or interest

Example 2. System documentation.

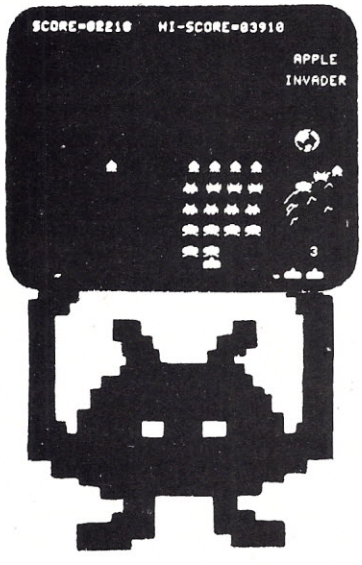






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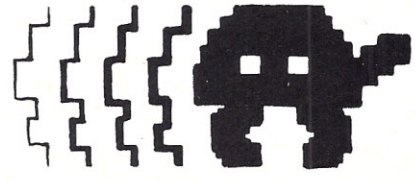


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Level II TRS-80 Graphics Code

Break the built-in Level II graphics code and use it.

Fred Blechman
7217 Bernadine Ave.
Canoga Park CA 91307

Have you noticed how some TRS-80 Level II programs run with unusual graphic figures, such as racing horses? While, to some degree, this can be done in Level I with SET commands, Level II has a graphic code built into the ROM BASIC that is much faster in both operation and programming. This article will describe the simple way to break the code and use it, illustrating the technique with a couple of short programs.

Displaying Graphics

The TRS-80 display screen is divided into 1024 printing locations, 0 to 1023 (64 across by 16 down). Normally, each of these locations is occupied by a letter, number, symbol or blank, i.e., a character. Each of these locations is a rectangular area divided into six segments (two columns of three rows each), as shown in Fig. 1. By proper use of the CHR$ command, you can light any single segment or combination of segments on your display. By putting these combinations together, you can form symbols, shapes, large letters, simulated playing fields, etc.

Fig. 2 shows the graphic code for each of the possible 64 segment "on" combinations, from "all segments off" (128) to "all segments on" (191). These are used in a program as CHR$(number). For example, if you used CHR$(157) in a program after a print instruction, you'd light all column 1 segments as well as the column 2 segment of row 2 at the current printing location. As another example, CHR$(140) lights both columns of row 2 at the current printing location.

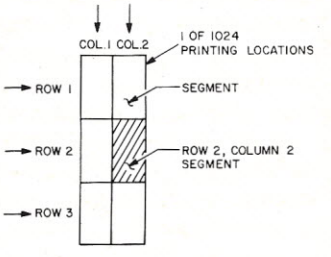


Fig. 1. How a printing location is divided into segments.

Actually, this graphic code is based on a binary code and is easy to remember if you crack the code. Look at Fig. 3. Notice

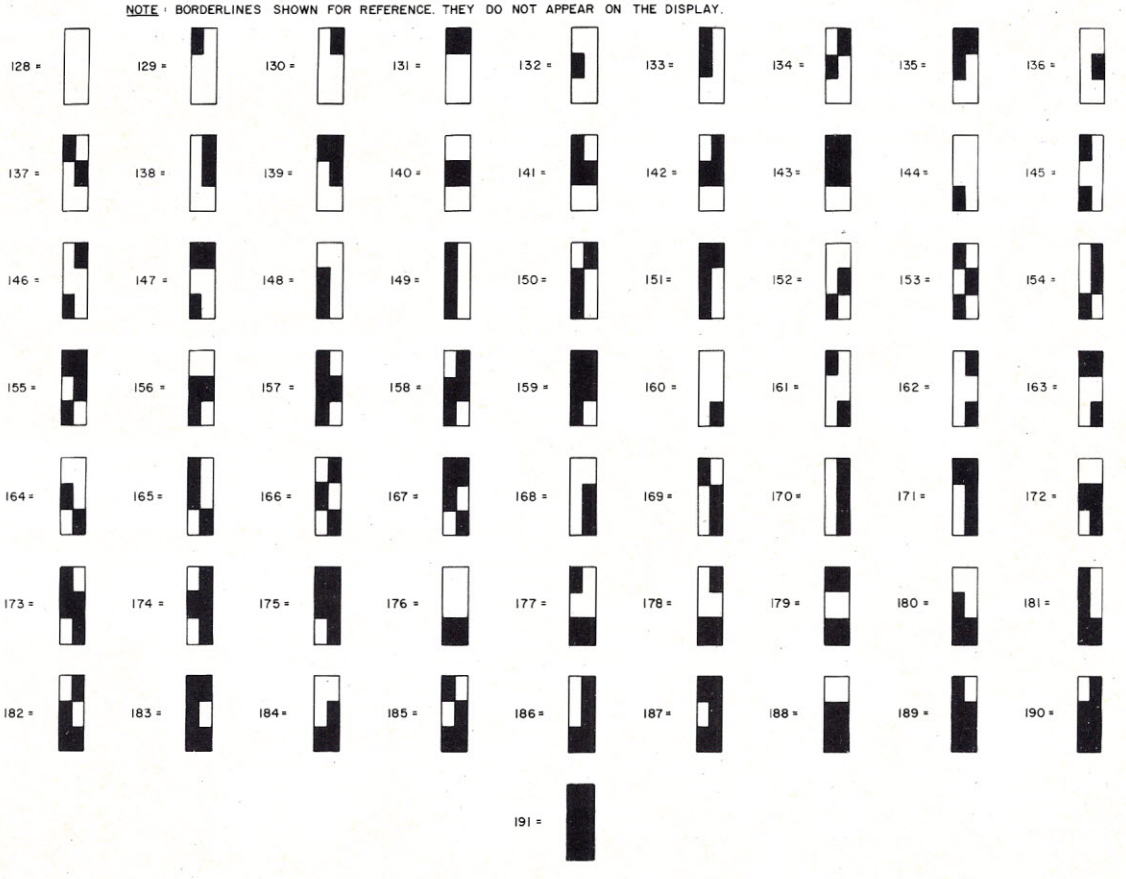


Fig. 2. TRS-80 graphic code. (■ = lighted segment)

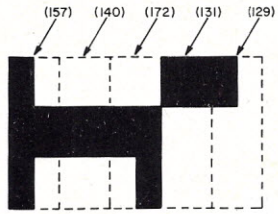


Fig. 4. Graphic horse or dog using five printing locations.

that each of the six segments in a printing location is assigned a decimal number representing the powers of 2. Going from left to right, and from top to bottom, starting with 1, each number is exactly twice the previous number. This is the basis of binary counting.

To determine the TRS-80 graphic code number, just add the numbers of each lighted segment, and then add 128! Fig. 3 shows some examples. Now you won't have to have Fig. 2 handy all the time, since you'll be able to quickly determine the number you want for every one of the possible 64 combinations. Remember, 128 is a total blank space, and 63 (total of all segments) plus 128 is equal to 191, a fully lighted space.

To design your own symbol or large letters, use the "TRS-80 Video Display Worksheet" in your manual (page E/1). Simply draw lightly in pencil whatever shape you want, noting that the heavier lines on the worksheet form the 1024 printing location rectangles, and the lighter lines subdivide these rectangles into six segments each. Now, convert your design to the proper combination of CHR$ numbers to "draw" this shape on your display screen.

An example will make this more understandable. Look at Fig. 4. This is a symbolic horse or dog composed of five CHR$ numbers on a single display line. You can place this "dog" anywhere on your screen with a PRINT@ instruction. How about a racing dog? Try the short program, which I call "RUN, SPOT, RUN," in Example 1.

Line 40 creates enough pause in the program for "Spot" to remain at one location long enough to be visually stable. Line 50 blanks out the space for the next image (try running without line 50 and watch what happens)! Line 70 (and the semicolons at the ends of lines 30 and 50) keeps "Spot" from being chopped into small pieces that scroll up the screen.

Perhaps you'd like to see your name in huge letters on the screen. Fine. Just follow the same procedure, but remember that you'll need several screen lines. Since you'll be commanding a relatively large number of locations on the screen, READ/DATA statements make sense. If you'd like to see *my* name in big letters (over 2 inches high), try the program in Example 2.

This by no means exhausts the possibilities of using the graphic code. You are only really limited by your imagination, patience and the size of the computer memory. Example 3 shows a listing of a 5-dog race, with graphic dogs, a finish line and winner announcement. ■

```
10 CLS
20 X=0
30 PRINT@X,CHR$(157);CHR$(140);CHR$(172);CHR$(131);CHR$(129);
40 FOR Y=1 TO 40:NEXT Y
50 PRINT@X,"      ";
60 X=X+1
70 IF X=1018 CLS:X=0
80 GOTO30
```

Example 1.

```
 10 CLS
 20 PRINT@266,CHR$(191);:GOSUB500
 30 PRINT@330,CHR$(191);:GOSUB500
 40 PRINT@394,CHR$(191);:GOSUB500
 50 PRINT@458,CHR$(191);:GOSUB500
 60 PRINT@522,CHR$(191);:GOSUB500
 65 GOTO65
 70 DATA191,191,191,191,191,191,191,191,128,128
 75 DATA 191,191,191,191,191,191,191,191,180
 80 DATA128,128,128,191,191,191,191,191,191,191
 85 DATA 191,191,128,128,191,191,191,191,191,191,191,189,144
 90 DATA191,191,128,128,128,128,128,128,128,128
 95 DATA 191,191,191,128,128,128,179,191,191,157,128,128
100 DATA191,191,191,128,128,128,128,128,128
105 DATA 128,128,191,191,191,128,128,139,191,191,191
110 DATA191,191,191,191,191,128,128,128,128
115 DATA 128,191,191,191,191,191,191,191,191,135,128,128,128
120 DATA191,191,191,191,191,191,128,128,128
125 DATA128,128,191,191,191,128,128,128,191,191,191
130 DATA191,191,128,128,128,128,128,128,128
135 DATA128,191,191,191,128,139,191,191,180,128,128,128,128
140 DATA191,191,191,128,128,128,128,128,128
145 DATA128,128,191,191,191,128,128,184,191,191,191
150 DATA 191,191,128,128,128,128,128,128,128
155 DATA128,191,191,191,128,128,130,191,191,189,176,128,128
160 DATA 191,191,191,191,191,191,191,191,191
165 DATA128,128,191,191,191,191,191,191,191,159,129
500 FORR=1T042
510 READX
520 PRINTCHR$(X);
530 NEXTR
540 RETURN
```

Example 2.

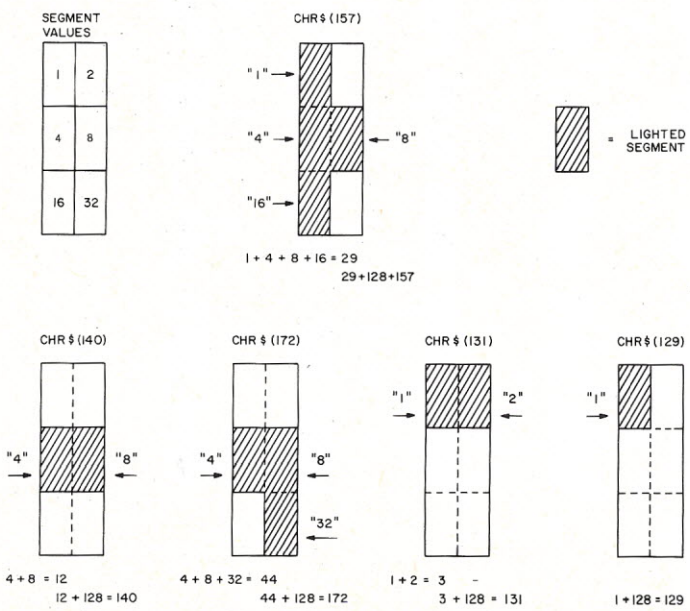


Fig. 3. Cracking the code.

```
 5 REM * DOGRACE WITH GRAPHIC DOGS - LEVEL II *
 6 REM * FRED BLECHMAN *
 7 REM * SET SPEED AT LINES 60-100 (A=A+2,ETC.) *
10 CLS
15 FOR Y=3 TO 29:SET(123,Y):NEXT
20 A=64:B=192:C=320:D=448:E=576
21 PRINT@A,CHR$(157);"1";CHR$(172);CHR$(131);CHR$(129);
22 PRINT@B,CHR$(157);"2";CHR$(172);CHR$(131);CHR$(129);
23 PRINT@C,CHR$(157);"3";CHR$(172);CHR$(131);CHR$(129);
24 PRINT@D,CHR$(157);"4";CHR$(172);CHR$(131);CHR$(129);
25 PRINT@E,CHR$(157);"5";CHR$(172);CHR$(131);CHR$(129);
26 GOTO 55
30 PRINT@A,CHR$(157);"1";CHR$(172);CHR$(131);CHR$(129);:GOTO50
31 PRINT@B,CHR$(157);"2";CHR$(172);CHR$(131);CHR$(129);:GOTO50
32 PRINT@C,CHR$(157);"3";CHR$(172);CHR$(131);CHR$(129);:GOTO50
33 PRINT@D,CHR$(157);"4";CHR$(172);CHR$(131);CHR$(129);:GOTO50
34 PRINT@E,CHR$(157);"5";CHR$(172);CHR$(131);CHR$(129);
50 IF A>120 PRINT@730,"#1 WINS!!!":END
51 IF B>248 PRINT@730,"#2 WINS!!!":END
52 IF C>376 PRINT@730,"#3 WINS!!!":END
53 IF D>504 PRINT@730,"#4 WINS!!!":END
54 IF E>632 PRINT@730,"#5 WINS!!!":END
55 X=RND(5)
56 ON X GOTO 60,70,80,90,100
60 PRINT@A,"      ";:A=A+1:GOTO30
70 PRINT@B,"      ";:B=B+1:GOTO31
80 PRINT@C,"      ";:C=C+1:GOTO32
90 PRINT@D,"      ";:D=D+1:GOTO33
100 PRINT@E,"      ";:E=E+1:GOTO34
```

Example 3.

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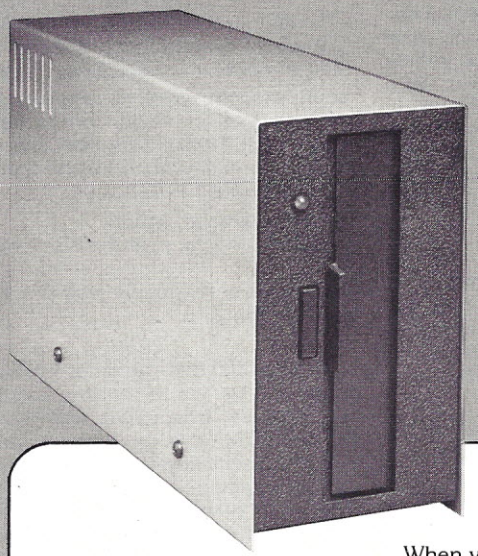
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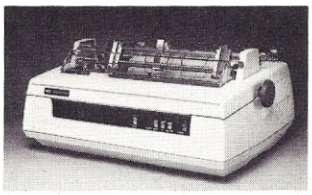
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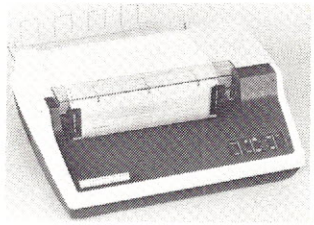
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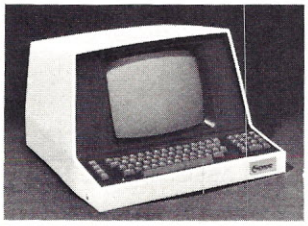
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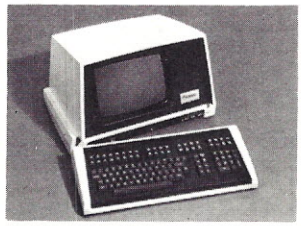
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CP/M and You

Is CP/M really the microcomputer cure-all? The answer is most definitely . . . maybe.

Thom Hogan
Basically Speaking
719 Anna Lee Lane
Bloomington IN 47401

More and more you hear about how good certain pieces of software are, and how they're going to make us machine independent. Probably at the forefront of this gossip is the CP/M system for floppy disks and 8080 or Z-80 computers. Is CP/M really that good, or are we being led down the path of publicity far outreaching capabilities?

I have read at least a half-dozen favorable reviews of the CP/M system, including one in *Kilobaud*. Computer stores have been touting CP/M as the "software bus" of the future and urging customers for almost every micro (except 6800s and 6502s) to get a disk system with CP/M. I, too, was bitten by the bug and decided to try out a Lifeboat Associates CP/M for the Micropolis system. My reaction, however, may take a few people by surprise—CP/M is good for some things, but it certainly is *not* the answer to everyone's dreams.

Introduction

Probably the easiest way to introduce you to the CP/M system is to lead you through the steps that you must take to get it operating on your computer. First, you must have a floppy disk. It doesn't have to be a specific make. At last report, the following drives have been supported by one or more sources of CP/M: Tarbell, Thinker Toys, Micropolis, North Star, Cromemco, Imsai, Digital Systems and ICOM. As you can see, it doesn't seem to matter which system you get (or does it? . . . more about this later).

About a year ago, I thought that the Micropolis Mod I drives were a good buy, so I bought one—my choice was already made, if you will. Therefore, I ordered a CP/M system from Lifeboat Associates (Suite 505, 2248 Broadway, New York NY 10024) and dreamt of the time when my computer would become "one of the gang."

When the package arrived, I took out the manuals and gave them a quick reading, which took about six hours. Caution: CP/M is not a system for the novice or for someone who balks at computer jargon. The manuals are comprehensive, but they present a lot of detailed material that most novices probably will be encountering for the first time, and, compared to the manuals from Apple, Radio Shack and Micropolis, the CP/M manuals read like dictionaries.

Lifeboat Associate's additions to the manuals weren't exactly helpful, either. Luckily, my work at a computer store has introduced me to a lot of different concepts, and I was immediately able to make some mental leaps that I don't think newcomers will make. In addition, my familiarity with the Micropolis system enabled me to understand exactly what was going on during all of the steps.

I suppose that most novices could get the CP/M system functioning on a Micropolis system without too much trouble. That's assuming, however, that they have one of the standard I/O systems that Micropolis has written drivers for. A customer at the store bought a Micropolis CP/M for his Exidy/Micropolis at the same time I got mine. His system still isn't working. The problem isn't that it's impossible, it's just that new I/O drivers need to be written, so we might as well do a good job and start from scratch. If you're not too proficient at writing assembly-language software, heaven help you if you need to make a change to a CP/M system.

Applying CP/M

OK, so I followed the instructions and soon was greeted with a 22K CP/M system. CP/M is a monitor control system that sits at the top of your RAM memory area. It takes about 2K of RAM for the basic monitor and stores many of the other features on diskette. Among the useful items you get are an editor, an assembler, a dynamic debugging tool and a system regenerator.

Ah, but for whom will they prove useful? I admit that they're of great value to me because I do an awful lot of custom software writing, but if you're out to just run existing programs, I doubt you'll even care what the DDT, STAT, ASM, ED, SAVEUSER or MOVECPM programs are. If you're just a weekend software tinkerer, you'll find that the Micropolis assembler, debugger and editor are all you really need.

Now, as I look at my CP/M system, I'm wondering what most people do with it. You see, the diskette that contains the CP/M systems and utilities has over 60K worth of programs on it. You figure it out: If you have only one single-density North Star drive, you've barely room left for a program, and we haven't even added a BASIC compiler yet! Not only that, if you have only one disk drive, you will soon find that you can't copy anything without having to go through computer gymnastics that'll get a 9.9 from the judges. And therein lies a story. . . .

Next on my list of acquisitions after CP/M was CBASIC. After all, I've heard a lot about using compilers, and every system I've owned up to now had BASIC interpreters. Now, you have to picture this carefully: There I was sitting at my com-

puter—a Sol with one Micropolis 143K drive. In my left hand was the CP/M disk; in my right, the CBASIC. Logic told me that I should boot the system from the CP/M disk, take it out, put in the CBASIC disk and then immediately start writing and running programs. I'm amazed at how often logic doesn't help me in computing.

You see, all that's on the CBASIC disk is CBASIC, and with a one-drive system, your program has to be on the same disk as BASIC. The only good way to create a program for CBASIC is to use the CP/M editor, which is on the other disk. Fine, you say, just load the editor from the one disk, and then when you're ready to save the result, slip in the CBASIC disk. Not so quick there, Buster. The editor program has to have (or create) a file before you can even edit. In other words, the results of your editing must be on the same disk as the editor.

I had two choices: either take the CBASIC programs off their disk and put them onto the CP/M disk or take the editor program off the CP/M disk and put it onto the CBASIC disk.

If you put the CBASIC programs onto the CP/M disk with a Micropolis Mod I drive, you will end up with 131K worth of programs on one disk, leaving you 11K+ for programs—not exactly what I call useful. Putting the editor on the CBASIC disk gives you about 75K of programs on the diskette, leaving 68K for programs; much better, but still not really enough.

The problem goes back to the editor. When you edit a program (i.e., create the listing), you get two files: a backup and the real file. Now a compiler BASIC such as CBASIC creates yet another file, this one called an intermediate file. So if you have a 10K program, you have just used up 30K of disk space. If you have two 10K programs, you will have filled up the Micropolis Mod I diskette again.

So what's the answer? The answer is to put all of your CP/M and CBASIC system and utilities on one diskette and buy another drive. This way you can create programs on that second drive and interchange diskettes whenever necessary. Great, but I'm just a graduate student trying to work my way through college while supporting a computer habit. I can't afford a second drive for another year or two.

I'm not the only one with problems, though. Think about the poor fellow who has two North Star single-density drives. That's 160K between them. I really doubt that a system like that, despite the fact that it has two drives, can support CP/M's penchant for eating up mass storage space. If you're really a CP/M user, I'd say have at least 250K of disk storage space, or you're going to a lot of extra trouble, which, frankly, I don't think is worth it.

Is that it, then? Do you think I'm just going to dismiss CP/M as a viable alternative because I don't have a second drive and 1 megabyte of floppy space? No. I also have some other qualms about what the CP/M system offers us.

Who Can Use It?

The big selling point for CP/M seems to be system interchangeability. If you have an 8080 or Z-80 and floppy disks, any software available on CP/M will work on your machine if you've got CP/M. I think that's probably the most misleading come-on I've heard in a long time. But let's not blame Lifeboat Associates or Digital Research for the problem. No, friends, the problem is ourselves.

Radio Shack is going to have a CP/M system for the TRS-80 soon. For some of the good programs that are floating around in CBASIC (such as Structured Systems Group software), those TRS-80 owners are going to find that they'll need four drives to make the system work smoothly. If you don't believe me, count them.

> **There is nothing of interest in this system for those who only wish to run existing applications, unless they have the equipment to support it.**

On the first drive (80K capacity), we're going to load the CP/M system and utilities, leaving maybe 20K of diskette space; that's not worth trying to use. On the second disk we're going to load CBASIC, which takes up another 60K. The third disk will have about 40 to 60K worth of programs; the last disk will have the data files for the business. While it's true that we could get rid of a lot of programs and utilities that aren't necessary, I doubt that it'll be done except as an emergency financial move by those who can't afford four drives.

What does this TRS-80 four-banger get you? I have no ill will towards Radio Shack computers; I own one. But I do have negative feelings toward the mentalities of computerists who are trying to make the TRS-80 perform like a Cromemco. Having used both considerably during the last year, I'll tell you right now that there's no comparison. All our hopes of making our *home computers* perform like *business computers* are just not going to make it happen. CP/M or no, I'll take a two-box Vector MZ system over a seven-box Radio Shack system any day.

You may think I'm starting to foam at the mouth. I'm not. At the computer store, we have one client who bought a Radio Shack TRS-80 computer for his home and then decided that he wanted to be able to take it to his business and use it there, also. What he wanted for the business end was a 10-megabyte hard disk drive and CP/M to hook up to his TRS-80! Even if I could (or would) do it for him, the keyboard on his TRS-80 would fail long before he filled one hard diskette. I also highly question the logic of putting in a disk system that operates faster than the host computer. I also wonder where I'm going to find room for 40K of RAM memory with only 32K worth of slots (CBASIC and CP/M really will only be worthwhile to those who have 40K or more because there will only remain a few kilobytes of program space with a 32K system).

Conclusion

So there you are: CP/M revealed. It's actually an excellent system, and I wholly recommend it to anyone doing program development. I also think that businesses that buy a complete system (at least 48K RAM and at least 250K storage on two drives) will find it useful, as, if you have enough memory and storage, it does open up a "software bus."

But hobbyists, small businesses, TRS-80, PET, Apple, Exidy and one-drive owners, beware. CP/M, like all systems, has its limitations. There is nothing of interest in this system for those who only wish to run existing applications, unless they have the equipment to support it.

I just know that I'm going to be assaulted for my review of the CP/M system, so in closing I'll prepare my defenses. CP/M is good for many things. I have addressed myself in this article primarily to the computer novice and the small businessperson. They have little or no need for the things that CP/M does so well. What CP/M means to the software developer and to the hardware enthusiast is another story. ■

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Reader Service index—page 241

John M. Blalock
3054 West Evans Dr.
Phoenix AZ 85023

A Printer for the KIM or SYM

The ubiquitous Selectric finds yet another home.

After I expanded my KIM-1 with a CRT terminal, 28K of additional RAM and Micro-Z's Microsoft BASIC ("Another KIM-1 Expansion," September 1979, p. 130), I felt the need to add hard-copy printout to the system. This article describes how I accomplished this goal and interfaced to my new SYM-1 as well.

The Selectric

Various models of IBM Selectric I/O typewriters are currently being removed from service and made available to the hobbyist for very reasonable prices. I was able to obtain a surplus Model 2970 Communications Terminal a short time ago for only $100! The reasonable price and high-quality printing available made it the printer of my choice. There was only one minor problem: I'd have to design the interface between the printer and the KIM.

The 2970 consisted of a power supply, logic assembly, cabinet and a Model 735 Selectric I/O typewriter. The Selectric contained all of the selector magnets (solenoids, for those who don't speak IBMese!) for tilt, rotate, index, carriage return and non-print (space).

I stripped the electronics out of the cabinet but left the power supply. Ac power to the supply and the Selectric is controlled by a circuit breaker on the cabinet, which is a convenient base for the Selectric to sit on. The remaining interface requirement was to ground the proper leads from the selector magnets with the correct coding and timing. The KIM, using its on-board timer and I/O capability, should easily handle these functions.

Interfacing Options

There are two ways to interface to a Selectric I/O—open loop or closed loop. With a closed loop system, signals generated by the Selectric mechanism are used to control the character timing. This is the preferred interface if heavy use is planned, but is somewhat more difficult to accomplish.

An open loop interface always must provide the worst-case timing. A character is sent out, and then the interface waits for the longest time it will take to print any character before sending another. The IBM manuals state that either method can be implemented successfully. However, open loop timing will slow down the throughput by a small amount.

The main disadvantage of the open loop system, in my opinion, is that the cycle clutch must stop the machine after each character. In a closed loop system, the next character can be transmitted prior to the clutch action, thus saving machine wear and tear. A closed loop system requires that the feedback contacts be carefully adjusted and that additional control lines be connected from the Selectric to the interface electronics.

The unexpanded KIM-1 only has 15 I/O lines available, and some of these on my KIM were already in use. I came up with the circuit shown in Fig. 1 to interface the KIM to the Selectric using only eight lines or one port address.

This is an open loop type of interface, but since I'm not planning on printing reams of paper daily, I don't expect the open loop disadvantages to be as important as the requirement for minimum I/O lines, minimum hardware and overall simplicity. It has been working satisfactorily now for several months. My biggest problem in getting it running was a misadjusted escapement mechanism inside the machine.

Implementing the Interface

I highly recommend that anyone attempting to interface or use a Selectric I/O typewriter obtain copies of IBM manuals 225-6595-1 and 225-1726-6. Along with the spare parts manual 123-1008-3, they contain a wealth of information on the machine's operation. Almost any

Listing 1. KIM interface program.

```
                        1 ;
                        2 ;       KIM SELECTRIC DRIVER
                        3 ;
                        4 ; Routine to convert ASCII in accumulator
                        5 ; to Selectric codes, and send to Selectric with
                        6 ; proper timing, case, etc. if location 0400 hex
                        7 ; is not equal to zero. Returns to KIM routine OUTCHR
                        8 ; with all registers unchanged from entry.  Uses no
                        9 ; page zero locations.
                       10 PAD:     equ $1700   ; Output port to Selectric
                       11 PADD:    equ $1701   ; Data direction register
                       12 Timer:   equ $1707   ; Divide by 1024
                       13 OUTCHR:  equ $1EA0   ; routine to send ASCII to CRT
                       14 TypeOn:  equ $0400   ; Zero = don't type
                       15 ASCII:   equ $0401   ; Temporary
                       16 CRflag:  equ $0402   ;   Storage
                       17 Temp:    equ $0403   ;     buffer
                       18 SFTflag: equ $0405   ;       locations
                       19          org $0406   ;
0406:08                20 Start:   PHP         ; Start of program
0407:48                21          PHA         ; Save registers
0408:AD 00 04          22          LDA TypeOn  ; Check if Typing desired
040B:D0 05             23          BNE Type    ; Yes, then Type
040D:68                24          PLA         ; No, restore registers
040E:28                25          PLP         ;
040F:4C A0 1E          26          JMP OUTCHR  ; and send to CRT
0412:A9 FF             27 Type:    LDA #$FF    ; Set port to output
0414:8D 01 17          28          STA PADD    ;
```

```
0417:68          29             PLA          ;  Get ASCII code
0418:8D 01 04    30             STA ASCII    ;  Save it
041B:48          31             PHA          ;  Save registers
041C:8A          32             TXA          ;
041D:48          33             PHA          ;
041E:98          34             TYA          ;
041F:48          35             PHA          ;
0420:D8          36             CLD          ;  Binary mode
0421:AD 01 04    37             LDA ASCII    ;  Get ASCII code
0424:C9 20       38             CMP #$20     ;  Is it a space?
0426:F0 17       39             BEQ Xspace   ;  Yes
0428:10 31       40             BPL GetCode  ;  Greater than space = valid code
042A:C9 0D       41             CMP #$0D     ;  less than space, is it Return?
042C:D0 15       42             BNE CKLF     ;  no, go check if is a line feed
042E:A9 04       43             LDA #$04     ;  yes, carriage return
0430:8D 02 04    44             STA CRflag   ;  Set flag to non-zero
0433:A8          45             TAY          ;  Will send four characters
0434:A9 00       46             LDA #$00     ;  but next three characters will
0436:8D 03 04    47             STA Temp     ;  be nulls to allow for return
0439:A9 40       48             LDA #$40     ;  Carriage return code
043B:A2 7F       49             LDX #$7F     ;  long delay
043D:D0 57       50             BNE CharOut  ;  Send the carriage return
043F:A9 81       51 Xspace:     LDA #$81     ;  Space code
0441:D0 45       52             BNE Out1     ;  Send it
0443:C9 0A       53 CKLF:       CMP #$0A     ;  Is code a line feed?
0445:D0 72       54             BNE Return   ;  No, ignore it
0447:AD 02 04    55             LDA CRflag   ;  Check flag
044A:F0 07       56             BEQ Linefeed ;Send LF if last not  Return
044C:A9 00       57             LDA #$00     ;  Last character sent was Return
044E:8D 02 04    58             STA CRflag   ;  reset the flag
0451:F0 66       59             BEQ Return   ;  and ignore the line feed
0453:A0 01       60 Linefeed:   LDY #$01     ;  one character
0455:A2 7F       61             LDX #$7F     ;  long delay
0457:A9 20       62             LDA #$20     ;  line feed code
0459:D0 3B       63             BNE CharOut  ;  send the line feed
045B:29 7F       64 GetCode:    AND #$7F     ;  mask off high bit
045D:AA          65             TAX          ;  put in index X
045E:BD A1 04    66             LDA Codes-$21,X  ; Get code in accumulator
0461:0A          67             ASLA         ;  shift left, put case in carry
0462:90 11       68             BCC LCchar   ;  Lower Case ?
0464:AC 05 04    69             LDY SFTflag  ;  no, check case flag
0467:D0 1F       70             BNE Out1     ;  Already in Upper Case, then send
0469:8D 03 04    71             STA Temp     ;  Need Case change, save code
046C:A0 02       72             LDY #$02     ;  will send two characters
046E:8C 05 04    73             STY SFTflag  ;  Set shift flag. Non zero = Upper
0471:A9 10       74             LDA #$10     ;  Shift code
0473:D0 15       75             BNE Out2     ;  Toggle shift, then send character
0475:AC 05 04    76 LCchar:     LDY SFTflag  ;  Lower case character. Check case.
0478:F0 0E       77             BEQ Out1     ;  Already in Lower case, then send
047A:8D 03 04    78             STA Temp     ;  Need Case change, save code
047D:A9 00       79             LDA #$00     ;  Reset shift flag.
047F:8D 05 04    80             STA SFTflag  ;  Zero = Lower Case
0482:A0 02       81             LDY #$02     ;  Will send two characters
0484:A9 10       82             LDA #$10     ;  Shift code
0486:D0 02       83             BNE Out2     ;  Toggle case, then send character
0488:A0 01       84 Out1:       LDY #$01     ;  Will send one character
048A:A2 00       85 Out2:       LDX #$00     ;  Don't forget to reset
048C:8E 02 04    86             STX CRflag   ;  the carriage return flag
048F:A2 40       87             LDX #$40     ;  normal delay time
0491:D0 03       88             BNE CharOut  ;  Send the character
0493:AD 03 04    89 Char2:      LDA Temp     ;  get additional character(s)
0496:8D 00 17    90 CharOut:    STA PAD      ;  Put in output port
0499:A9 0A       91             LDA #$0A     ;  0A = 10 milliseconds
049B:8D 07 17    92             STA Timer    ;  set timer
049E:8D 07 17    93             STA Timer    ;  make sure
04A1:AD 07 17    94 Delay1:     LDA Timer    ;  check timer
04A4:10 FB       95             BPL Delay1   ;  still counting, check again
04A6:A9 00       96             LDA #$00     ;  Timer timed out
04A8:8D 00 17    97             STA PAD      ;  turn off port
04AB:8E 07 17    98             STX Timer    ;  start delay time
04AE:8E 07 17    99             STX Timer    ;  make sure
```

```
04B1:AD 07 17   100 Delay2:     LDA Timer    ;  check timer
04B4:10 FB      101             BPL Delay2   ;  still counting, check again
04B6:88         102             DEY          ;  Delay over, More Characters?
04B7:D0 DA      103             BNE Char2    ;  Yes, then send them
04B9:68         104 Return:     PLA          ;  No, restore all registers
04BA:A8         105             TAY          ;
04BB:68         106             PLA          ;
04BC:AA         107             TAX          ;
04BD:68         108             PLA          ;
04BE:28         109             PLP          ;
04BF:4C A0 1E   110             JMP OUTCHR   ;  and send character to CRT
                111  ;
                112  ;  Control Code Table for IBM Ball 952
                113  ;   Bit    1=function
                114  ;    0       Tilt 1
                115  ;    1       Tilt 2
                116  ;    2       Rotate 1
                117  ;    3       Rotate 2
                118  ;    4       Rotate 2A
                119  ;    5       Rotate -5
                120  ;    6       Check

  Return     2   1209 04B9
  SFTflag    2   1029 0405
  Start      2   1030 0406
  Temp       2   1027 0403
  Timer      2   5895 1707
  Type       2   1042 0412
  TypeOn     2   1024 0400
  Xspace     2   1087 043F
```

```
                121  ;    7       Upper Case
                122  ;
                123  ;                        ASCII   Printed
04C2:C1         124 Codes: byte $C1 ;    21     !
04C3:C7         125        byte $C7 ;    22     "
04C4:43         126        byte $43 ;    23     #
04C5:41         127        byte $41 ;    24     $
04C6:DC         128        byte $DC ;    25     %
04C7:5D         129        byte $5D ;    26     &
04C8:E7         130        byte $E7 ;    27     '
04C9:FF         131        byte $FF ;    28     (
04CA:EF         132        byte $EF ;    29     )
04CB:EB         133        byte $EB ;    2A     *
04CC:DB         134        byte $DB ;    2B     +
04CD:42         135        byte $42 ;    2C     ,
04CE:5E         136        byte $5E ;    2D     -
04CF:40         137        byte $40 ;    2E     .
04D0:7E         138        byte $7E ;    2F     /
04D1:5F         139        byte $5F ;    30     0
04D2:7F         140        byte $7F ;    31     1
04D3:5B         141        byte $5B ;    32     2
04D4:7B         142        byte $7B ;    33     3
04D5:4F         143        byte $4F ;    34     4
04D6:6F         144        byte $6F ;    35     5
04D7:4B         145        byte $4B ;    36     6
04D8:6B         146        byte $6B ;    37     7
04D9:67         147        byte $67 ;    38     8
04DA:47         148        byte $47 ;    39     9
04DB:C2         149        byte $C2 ;    3A     :
04DC:CB         150        byte $CB ;    3B     ;
04DD:FB         151        byte $FB ;    3C     <
04DE:C3         152        byte $C3 ;    3D     =
04DF:DD         153        byte $DD ;    3E     >
04E0:DE         154        byte $DE ;    3F     ?
04E1:5C         155        byte $5C ;    40    "at"
04E2:FC         156        byte $FC ;    41     A
04E3:D8         157        byte $D8 ;    42     B
04E4:F8         158        byte $F8 ;    43     C
```

```
04E5:CC          159        byte $CC ;   44    D
04E6:EC          160        byte $EC ;   45    E
04E7:C8          161        byte $C8 ;   46    F
04E8:E8          162        byte $E8 ;   47    G
04E9:E4          163        byte $E4 ;   48    H
04EA:C4          164        byte $C4 ;   49    I
04EB:FD          165        byte $FD ;   4A    J
04EC:D9          166        byte $D9 ;   4B    K
04ED:F9          167        byte $F9 ;   4C    L
04EE:CD          168        byte $CD ;   4D    M
04EF:ED          169        byte $ED ;   4E    N
04F0:C9          170        byte $C9 ;   4F    O
04F1:E9          171        byte $E9 ;   50    P
04F2:E5          172        byte $E5 ;   51    Q
04F3:C5          173        byte $C5 ;   52    R
04F4:DA          174        byte $DA ;   53    S
04F5:FA          175        byte $FA ;   54    T
04F6:CE          176        byte $CE ;   55    U
04F7:EE          177        byte $EE ;   56    V
04F8:CA          178        byte $CA ;   57    W
04F9:EA          179        byte $EA ;   58    X
04FA:E6          180        byte $E6 ;   59    Y
04FB:C6          181        byte $C6 ;   5A    Z
04FC:FF          182        byte $FF ;   5B    (
04FD:DF          183        byte $DF ;   5C    |
04FE:EF          184        byte $EF ;   5D    )
04FF:CF          185        byte $CF ;   5E    ^
0500:FE          186        byte $FE ;   5F    _
0501:E7          187        byte $E7 ;   60    `
0502:7C          188        byte $7C ;   61    a
0503:58          189        byte $58 ;   62    b
0504:78          190        byte $78 ;   63    c
0505:4C          191        byte $4C ;   64    d
0506:6C          192        byte $6C ;   65    e
0507:48          193        byte $48 ;   66    f
0508:68          194        byte $68 ;   67    g
0509:64          195        byte $64 ;   68    h
050A:44          196        byte $44 ;   69    i
050B:7D          197        byte $7D ;   6A    j
050C:59          198        byte $59 ;   6B    k
050D:79          199        byte $79 ;   6C    l
050E:4D          200        byte $4D ;   6D    m
050F:6D          201        byte $6D ;   6E    n
0510:49          202        byte $49 ;   6F    o
0511:69          203        byte $69 ;   70    p
0512:65          204        byte $65 ;   71    q
0513:45          205        byte $45 ;   72    r
0514:5A          206        byte $5A ;   73    s
0515:7A          207        byte $7A ;   74    t
0516:4E          208        byte $4E ;   75    u
0517:6E          209        byte $6E ;   76    v
0518:4A          210        byte $4A ;   77    w
0519:6A          211        byte $6A ;   78    x
051A:66          212        byte $66 ;   79    y
051B:46          213        byte $46 ;   7A    z
051C:FF          214        byte $FF ;   7B    {
051D:C0          215        byte $C0 ;   7C    cent sign
051E:EF          216        byte $EF ;   7D    }
051F:80          217        byte $80 ;   7E    del
0520:80          218        byte $80 ;   7F    del

reference name table

                          value
name      size        dec   hex
ASCII        2       1025  0401
CKLF         2       1091  0443
CRflag       2       1026  0402
Char2        2       1171  0493
CharOut      2       1174  0496
Codes        2       1218  04C2
Delay1       2       1185  04A1
Delay2       2       1201  04B1
GetCode      2       1115  045B
LCchar       2       1141  0475
Linefeed     2       1107  0453
OUTCHR       2       7840  1EA0
Out1         2       1160  0488
Out2         2       1162  048A
PAD          2       5888  1700
PADD         2       5889  1701
```

Listing 2 . SYM interface program.

```
                    1 ;       SYM SELECTRIC DRIVER
                    2 ;
                    3 ; Routine to convert ASCII in accumulator
                    4 ; to Selectric codes, and send to Selectric with
                    5 ; proper timing, case, etc. if location 1FFF hex
                    6 ; is not equal to zero. Returns to SYM routine TOUT
                    7 ; with all registers unchanged from entry.  Uses no
                    8 ; page zero locations.
                    9 ; Change OUTVEC to 1EE0 to use. ( SD 1EE0, A664 )
                   10 ; In response to "Memory Size ?" from BASIC, enter 7903
                   11 ; This routine uses the top 288 bytes of an 8K SYM memory.
                   12 ;
                   13 PAD:         equ $A800  ;  Output port to Selectric
                   14 PADD:        equ $A802  ;  Data direction register
                   15 Timer:       equ $A417  ;  Divide by 1024
                   16 TOUT:        equ $8AA0  ;  SYM routine, sends ASCII to CRT
                   17 TypeOn:      equ $1FFF  ;  Zero = Don't type
                   18 ASCII:       equ $1FFE  ;  Temporary
                   19 CRflag:      equ $1FFD  ;   Storage
                   20 Temp:        equ $1FFC  ;    buffer
                   21 SFTflag:     equ $1FFB  ;     locations
                   22              org $1EE0  ;
1EE0:08            23 Start:       PHP        ;  Start of program
1EE1:48            24              PHA        ;  Save flags & accumulator
1EE2:AD FF 1F      25              LDA TypeOn ;  Check if Typing desired
1EE5:D0 05         26              BNE Type   ;  Yes, then Type
1EE7:68            27              PLA        ;  No, restore accumulator
1EE8:28            28              PLP        ;  and flags
1EE9:4C AU 8A      29              JMP TOUT   ;  and send to CRT
1EEC:A9 FF         30 Type:        LDA #$FF   ;  Set port to output
1EEE:8D 02 A8      31              STA PADD   ;
1EF1:68            32              PLA        ;  Get ASCII code
1EF2:8D FE 1F      33              STA ASCII  ;  Save it
1EF5:48            34              PHA        ;  Save registers
1EF6:8A            35              TXA        ;
1EF7:48            36              PHA        ;
1EF8:98            37              TYA        ;
1EF9:48            38              PHA        ;
1EFA:D8            39              CLD        ;  Binary mode
1EFB:AD FE 1F      40              LDA ASCII  ;  Get ASCII code
1EFE:C9 20         41              CMP #$20   ;  Is it a space?
1F00:F0 17         42              BEQ Xspace ;  Yes, then send a space
1F02:10 31         43              BPL GetCode ; > space is valid code
1F04:C9 0D         44              CMP #$0D   ;  < space, is it Return?
1F06:D0 15         45              BNE CKLF   ;  no, go check if it is a line feed
1F08:A9 04         46              LDA #$04   ;  yes, carriage return
1F0A:8D FD 1F      47              STA CRflag ;  Set flag to non-zero
1F0D:A8            48              TAY        ;  Will send four characters
1F0E:A9 00         49              LDA #$00   ;  but next three characters will
```

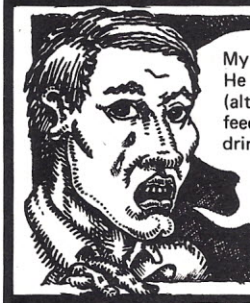
Selecric I/O could be interfaced using the information in this article and in those manuals.

The 2970 Selectric was originally used in a motel/hotel reservation system, according to its type ball, which had funny little symbols that would only be useful in printing a hotel bill, uppercase letters only, the numbers and only a few standard punctuation marks. I obtained a number 952 ball to replace it.

The 952 ball has both upper and lowercase letters, numbers and most of the ASCII symbols. I did not convert the interposers of the machine to match the new ball, so it was useless as a typewriter. But I'm only using it as a printer, so why waste the time and money on the interposers?

Another peculiarity (?) of the 2970 Selectric is that a space is considered a printable character and is obtained by energizing the non-print magnet along with one or more of the tilt, rotate or check magnets. I understand that a space is a control character on some of the other Selectric I/O machines. They would require slight modification of the hardware and software interfaces contained in

"A TRUE STORY"

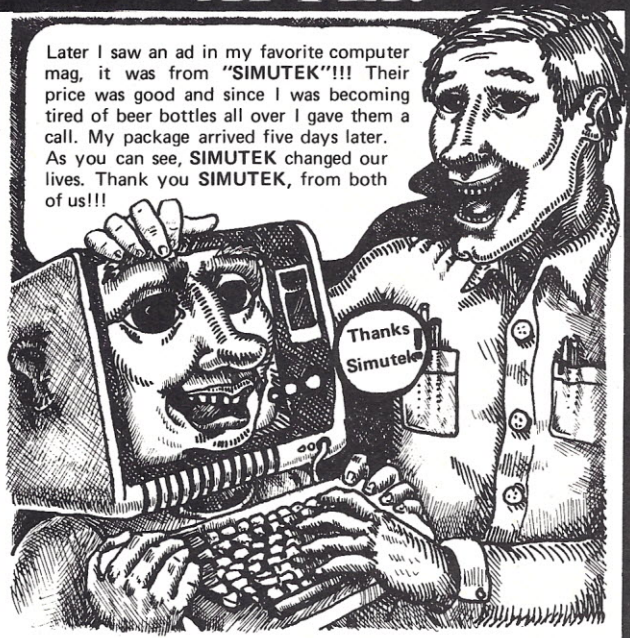


My **TRS-80** was becoming a degenerate. He was upset because of the tasteless, (although expensive), software I had been feeding him. When he started smoking and drinking I put my foot down. "What do you want from me?," I screamed in desperation. **"SIMUTEK"** he said in his usual monotone, over and over again. "What was **SIMUTEK**"? I wondered.

BEFORE



AFTER



Later I saw an ad in my favorite computer mag, it was from **"SIMUTEK"!!!** Their price was good and since I was becoming tired of beer bottles all over I gave them a call. My package arrived five days later. As you can see, **SIMUTEK** changed our lives. Thank you **SIMUTEK**, from both of us!!!

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!!! WHOLESALE !!!

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ **PACKAGE ONE** ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

GRAPHIC-TREK "2000" — This full graphics, real time game is full of fast, exciting action! Exploding photon torpedoes and phasers fill the screen! You must actually navigate the enterprise to dock with the giant space stations as well as to avoid klingon torpedoes! Has shields, galactic memory readout, damage reports, long range sensors, etc! Has 3 levels for beginning, average, or expert players! ★ **INVASION WORG** — Time: 3099, Place: Earth's Solar System Mission: As general of Earth's forces, your job is to stop the Worg invasion and destroy their outposts on Mars, Venus, Saturn, Neptune, etc! Earth's Forces: Androids — Space Fighters — Lazer Cannon — Neutrino Blasters! Worg Forces: Robots — Saucers — Disintegrators — Proton Destroyers! Multi level game lets you advance to a more complicated game as you get better! ★ **STAR WARS** — Manuever your space fighter deep into the nucleus of the Death Star! Drop your bomb, then escape via the only exit. This graphics game is really fun! May the Force be with you! ★ **SPACE TARGET** — Shoot at enemy Ships with your missiles. If they eject in a parachute, capture them — or if you're cruel, destroy them! Full graphics, real time game! ★ **SAUCERS** — This fast action graphics game has a time limit! Can you be the commander to win the distinguished cross! Requires split second timing to win! Watch out!

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ **PACKAGE TWO** ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

CHECKERS 2.1 — Finally! A checkers program that will challenge everyone! Expert as well as amateur! Uses 3-ply tree search to find best possible move. Picks randomly between equal moves to assure you of never having identical games. ★ **POKER FACE** — The computer uses psychology as well as logic to try and beat you at poker. Cards are displayed using TRS-80's full graphics. Computer raises, calls, and sometimes even folds! Great practice for your Saturday night poker match! (Plays 5 card draw). ★ **PSYCHIC** — Tell the computer a little about yourself and he'll predict things about you, you won't believe! A real mind bender! Great amusement for parties. ★ **TANGLE MANIA** — Try and force your opponent into an immobile position. But watch out, they're doing the same to you! This graphics game is for 2 people and has been used to end stupid arguments. (And occasionally starts them!) ★ **WORD SCRAMBLE** — This game is for two or more people. One person inputs a word to the computer while the others look away. The computer scrambles the word, then keeps track of wrong guesses.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ **PACKAGE THREE** ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

POETRY — This program lets you choose the subject as well as the mood of the poem you want. You give TRS-80 certain nouns or names, then the mood, and it does the rest! It has a 1000-word + vocabulary of nouns, verbs, adjectives and adverbs! ★ **ELECTRIC ARTIST** — Manual: draw, erase, move as well as, Auto: draw, erase and move. Uses graphics bits not bytes. Saves drawing on tape or disk! ★ **GALACTIC BATTLE** — The Swineus enemy have long range phasers but cannot travel at warp speed! You can, but only have short range phasers! Can you blitzkrieg the enemy without getting destroyed! Full graphics — real time! ★ **WORD MANIA** — Can you guess the computer's words using your human intuitive and logical abilities? You'll need to, to beat the computer! ★ **AIR COMMAND** — Battle the Kamikaze pilots. Requires split second timing. This is a FAST action arcade game.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ **PACKAGE FOUR** ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

LIFE — This Z-80 machine language program uses full graphics! Over 100 generations per minute make it truly animated! You make your starting pattern, the computer does the rest! Program can be stopped and changes made! Watch it grow! ★ **SPACE LANDER** — This full graphics simulator lets you pick what planet, asteroid or moon you wish to land on! Has 3 skill levels that make it fun for everyone. ★ **GREED II** — Multi-level game is fun and challenging! Beat the computer at this dice game using your knowledge of odds and luck! Computer keeps track of his winnings and yours. Quick fast action. This game is not easy! ★ **THE PHARAOH** — Rule the ancient city of Alexandria! Buy or sell land. Keep your people from revolting! Stop the rampaging rats. Requires a true political personality to become good! ★ **ROBOT HUNTER** — A group of renegade robots have escaped and are spotted in an old ghost town on Mars! Your job as "Robot Hunter" is to destroy the pirate machines before they kill any more settlers! Exciting! Challenging! Full graphics!

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ **PACKAGE FIVE** ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

SUPER HORSERACE — Make your bets just like at the real racetrack! 8 horses race in this spectacular graphic display! Up to 9 people can play! Uses real odds but has that element of chance you see in real life! Keeps track of everyone's winnings and losses. This is one of the few computer simulations that can actually get a room of people cheering! ★ **MAZE MOUSE** — The mouse with a mind! The computer generates random mazes of whatever size you specify, then searches for a way out! The second time, he'll always go fastest route! A true display of artificial intelligence! Full graphics, mazes & mouses! ★ **AMOEBA KILLER** — You command a one man submarine that has been shrunken to the size of bacteria in this exciting graphic adventure! Injected into the president's bloodstream, your mission is to destroy the deadly amoeba infection ravaging his body! ★ **LOGIC** — This popular game is based on Mastermind but utilizes tactics that make it more exciting and challenging — has 2 levels of play to make it fun for everyone. ★ **SUBMARINER** — Shoot torpedoes at the enemy ships to get points. Fast action graphics, arcade type game is exciting and fun for everybody!

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ **PACKAGE SIX** ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

20 HOME FINANCIAL PROGRAMS — Figures amortization, annuities, depreciation rates, interest tables, earned interest on savings and much, much more. These programs will get used again and again. A must for the conscientious, inflation minded person.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ **PACKAGE SEVEN** ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

BACKGAMMON 5.0 — 2 different skill levels make this game a challenge to average or advanced players. (Not recommended for beginners). Looks for best possible move to beat you! FANTASTIC GRAPHICS. Plays doubles and uses international rules. ★ **SPEED READING** — Increases your reading speed. Also checks for comprehension of material. Great for teenagers and adults to improve reading skills. ★ **PT 109** — Drop depth charges on moving subs. Lower depths get higher points in this fast action graphics game. ★ **YAHTZEE** — Play Yahtzee with the computer. This popular game is even more fun and challenging against a TRS-80! ★ **WALL STREET** — Can you turn your $50,000 into a million dollars? That's the object of this great game. Simulates an actual stock market!

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✓ Reader Service index—page 241

```
1F10:8D FC 1F    50              STA Temp    ;  be nulls to allow for return
1F13:A9 40       51              LDA #$40    ;  Carriage return code
1F15:A2 7F       52              LDX #$7F    ;  long delay
1F17:D0 57       53              BNE CharOut ; Send the carriage return
1F19:A9 81       54 Xspace:      LDA #$81    ;  Space code
1F1B:D0 45       55              BNE Out1    ;  Send it
1F1D:C9 0A       56 CKLF:        CMP #$0A    ;  Is code a line feed?
1F1F:D0 72       57              BNE Return  ;  No, ignore it
1F21:AD FD 1F    58              LDA CRflag  ;  Check flag
1F24:F0 07       59              BEQ Linefeed ;Send LF if last not Return
1F26:A9 00       60              LDA #$00    ;  Last character sent was Return
1F28:8D FD 1F    61              STA CRflag  ;  reset the flag
1F2B:F0 66       62              BEQ Return  ;  and ignore the line feed
1F2D:A0 01       63 Linefeed:    LDY #$01    ;  one character
1F2F:A2 7F       64              LDX #$7F    ;  long delay
1F31:A9 20       65              LDA #$20    ;  line feed code
1F33:D0 3B       66              BNE CharOut ;  send the line feed
1F35:29 7F       67 GetCode:     AND #$7F    ;  mask off high bit
1F37:AA          68              TAX         ;  put in index X
1F38:BD 7B 1F    69              LDA Codes-$21,X ; Get code in Accumulator
1F3B:0A          70              ASLA        ;  shift left, put case in carry
1F3C:90 11       71              BCC LCchar  ;  Lower Case ?
1F3E:AC FB 1F    72              LDY SFTflag ;  no, check case flag
1F41:D0 1F       73              BNE Out1    ;  In Upper Case, send character
1F43:8D FC 1F    74              STA Temp    ;  Need Case change, save code
1F46:A0 02       75              LDY #$02    ;  will send two characters
1F48:8C FB 1F    76              STY SFTflag ;  Set shift flag. Non zero = Upper
1F4B:A9 10       77              LDA #$10    ;  Shift code
1F4D:D0 15       78              BNE Out2    ;  Toggle shift, then send character
1F4F:AC FB 1F    79 LCchar:      LDY SFTflag ;  Lower case character. Check case.
1F52:F0 0E       80              BEQ Out1    ;  In lower case, send character
1F54:8D FC 1F    81              STA Temp    ;  Need Case change, save code
1F57:A9 00       82              LDA #$00    ;  Reset shift flag.
1F59:8D FB 1F    83              STA SFTflag ;   Zero = Lower Case
1F5C:A0 02       84              LDY #$02    ;  Will send two characters
1F5E:A9 10       85              LDA #$10    ;  Shift code
1F60:D0 02       86              BNE Out2    ;  Toggle case, then send character
1F62:A0 01       87 Out1:        LDY #$01    ;  Will send one character
1F64:A2 00       88 Out2:        LDX #$00    ;  Don't forget to reset
1F66:8E FD 1F    89              STX CRflag  ;  the carriage return flag
1F69:A2 40       90              LDX #$40    ;  normal delay time
1F6B:D0 03       91              BNE CharOut ;  Send the character
1F6D:AD FC 1F    92 Char2:       LDA Temp    ;  get additional character
1F70:8D 00 A8    93 CharOut:     STA PAD     ;  Put in output port
1F73:A9 0A       94              LDA #$0A    ;  0A = 10 milliseconds
1F75:8D 17 A4    95              STA Timer   ;  set timer
1F78:8D 17 A4    96              STA Timer   ;  make sure
1F7B:AD 17 A4    97 Delay1:      LDA Timer   ;  check timer
1F7E:10 FB       98              BPL Delay1  ;  still counting, check again
1F80:A9 00       99              LDA #$00    ;  Timer timed out
1F82:8D 00 A8   100              STA PAD     ;  turn off port
1F85:8E 17 A4   101              STX Timer   ;  start delay time
1F88:8E 17 A4   102              STX Timer   ;  make sure
1F8B:AD 17 A4   103 Delay2:      LDA Timer   ;  check timer
1F8E:10 FB      104              BPL Delay2  ;  still counting, check again
1F90:88         105              DEY         ;  Delay over, Any more Characters?
1F91:D0 DA      106              BNE Char2   ;  Yes, then send them
1F93:68         107 Return:      PLA         ;  No, restore all registers
1F94:A8         108              TAY         ;
1F95:68         109              PLA         ;
1F96:AA         110              TAX         ;
1F97:68         111              PLA         ;
1F98:28         112              PLP         ;
1F99:4C A0 8A   113              JMP TOUT    ;  and send character to CRT
                114  ;
                115  ;  Control Code Table for IBM Ball 952
                116  ;   Bit    1=function
                117  ;    0       Tilt 1
                118  ;    1       Tilt 2
                119  ;    2       Rotate 1
                120  ;    3       Rotate 2
                121  ;    4       Rotate 2A
                122  ;    5       Rotate -5
                123  ;    6       Check
                124  ;    7       Upper Case
                125  ;
                126  ;                      ASCII  Printed
1F9C:C1         127 Codes: byte $C1 ;   21     !
1F9D:C7         128        byte $C7 ;   22     "
1F9E:43         129        byte $43 ;   23     #
1F9F:41         130        byte $41 ;   24     $
1FA0:DC         131        byte $DC ;   25     %
1FA1:5D         132        byte $5D ;   26     &
1FA2:E7         133        byte $E7 ;   27     '
1FA3:FF         134        byte $FF ;   28     (
1FA4:EF         135        byte $EF ;   29     )
1FA5:EB         136        byte $EB ;   2A     *
1FA6:DB         137        byte $DB ;   2B     +
1FA7:42         138        byte $42 ;   2C     ,
1FA8:5E         139        byte $5E ;   2D     -
1FA9:40         140        byte $40 ;   2E     .
1FAA:7E         141        byte $7E ;   2F     /
1FAB:5F         142        byte $5F ;   30     0
1FAC:7F         143        byte $7F ;   31     1
1FAD:5B         144        byte $5B ;   32     2
1FAE:7B         145        byte $7B ;   33     3
1FAF:4F         146        byte $4F ;   34     4
1FB0:6F         147        byte $6F ;   35     5
1FB1:4B         148        byte $4B ;   36     6
1FB2:6B         149        byte $6B ;   37     7
```

this article, but the changes should not be difficult to accomplish.

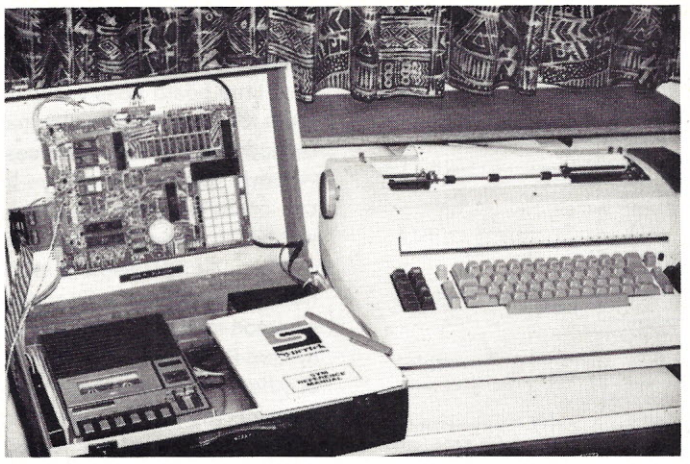
The control characters consist of Shift, Carriage Return and Index. Each time the Shift line is brought low, the machine changes case. It will stay in that case until the Shift line is pulsed again. This means that the KIM must keep track of what case the machine is in, only changing case when necessary. The SHIFT SYNC switch, a push-button type mounted on the Selectric, is used to initially synchronize it and the KIM as to which case is selected.

The Carriage Return function on the Selectric both returns the carriage to the left margin and advances the paper to the next print line. Therefore, the KIM must suppress any line-feed characters sent immediately after a Carriage Return, or double-spaced printing will result. Index is just IBMese for line feed and requires no further explanation.

The Check line is used in this interface scheme to differentiate between the printable and control characters. If CK in Fig. 1 is low, then $\overline{CK}$ will be high. Therefore, line D6, for example, activates U5B (ROT 5) and not U5C (Return). If CK were high, the reverse would be true. This multiplexing of the data lines allows the eight-bit port to control the eleven different signals needed by the Selectric.

Fig. 1 is the schematic of the complete hardware interface I am using. U1 and U2 are mounted on a small board in the KIM cabinet. A six-foot twisted-pair cable connects from this board to another small board in the 2970 cabinet. The numbers on the lines inside the dotted oval correspond to the pin numbers of the DB-25 connectors I used to terminate the cable.

The second board contains U3, U4, U5 and eleven identical relay driver circuits as shown. The collectors of the MJE-340s are wired to the selector magnets using the original 2970 cables. The other sides of the selector magnets are connected by the original wiring to the +48 volt output from the power supply in the 2970 cabinet.



The Selectric and the SYM-1.

Software

Most of the work of the interfacing has been left up to the KIM's software. It must provide for code conversion from ASCII to the codes that correspond to the appropriate tilt, rotate and check magnet combination for the type ball or select the required control character. It must keep track of the machine's case—upper or lower—suppress line feeds immediately preceded by carriage returns, etc. Also, it must provide the pulses with the proper timing.

All pulses should have a 10 millisecond duration with at least 67.5 milliseconds wait from the start of one pulse to the occurence of another, except for Index and Carriage Return, which require even longer delays. Listing 1 accomplishes all of these functions in the KIM.

This program listing should be reasonably easy to follow. If not, I wasted a lot of time on comments. It is located in my block of memory starting at 0400 hex. To prevent possible interference with other programs, it uses no page zero locations. If you relocate the program, the scratch locations at $0400-$0405 and the references to them must be changed. The rest of the code should be completely relocatable without change.

To output a character, most application software packages use a JSR OUTCHR (20 A0 1E). This is located at $2A51 in my version of BASIC, for example. Change it to JSR Start (20 06 04) to use the Selectric driver program. The program ends with a JMP to OUTCHR, which will then print the character on the terminal and return to the application program.

If location 0400 hex is a zero, the character will not be printed on the Selectric. Changing $0400 to any other value will cause the character to be printed. This can be done from BASIC using POKE 1024,9 to start printing and POKE 1024,0 to stop it.

The SYM-1

Shortly after I got the Selectric working with the KIM, I obtained one of Synertek's new SYM-1 boards. Although it uses essentially the same expansion bus as the KIM and has many other similarities, none of my KIM programs that use the onboard keypad and display would run on the SYM without major changes due to the way the SYM addresses its peripherals. Tom Pittman's Tiny BASIC, however, was easier to interface to the SYM than to the KIM! The SYM's expanded monitor (version 1.1), BASIC on ROM, higher-speed cassette interface and up to 4K of RAM on-board are excellent features.

Listing 2 is the revised Selectric driver software for the SYM. The small board plugged onto the SYM's auxiliary applications connector to the left side of it in the accompanying photo contains U1 and U2 of the hardware interface. The cable connected to it runs to the Selectric. It connects to the SYM +5 V, ground and port B of 6522 U28.

```
1FB3:67          150        byte  $67 ;    38     8
1FB4:47          151        byte  $47 ;    39     9
1FB5:C2          152        byte  $C2 ;    3A     :
1FB6:CB          153        byte  $CB ;    3B     ;
1FB7:FB          154        byte  $FB ;    3C     <
1FB8:C3          155        byte  $C3 ;    3D     =
1FB9:DD          156        byte  $DD ;    3E     >
1FBA:DE          157        byte  $DE ;    3F     ?
1FBB:5C          158        byte  $5C ;    40     "at"
1FBC:FC          159        byte  $FC ;    41     A
1FBD:D8          160        byte  $D8 ;    42     B
1FBE:F8          161        byte  $F8 ;    43     C
1FBF:CC          162        byte  $CC ;    44     D
1FC0:EC          163        byte  $EC ;    45     E
1FC1:C8          164        byte  $C8 ;    46     F
1FC2:E8          165        byte  $E8 ;    47     G
1FC3:E4          166        byte  $E4 ;    48     H
1FC4:C4          167        byte  $C4 ;    49     I
1FC5:FD          168        byte  $FD ;    4A     J
1FC6:D9          169        byte  $D9 ;    4B     K
1FC7:F9          170        byte  $F9 ;    4C     L
1FC8:CD          171        byte  $CD ;    4D     M
1FC9:ED          172        byte  $ED ;    4E     N
1FCA:C9          173        byte  $C9 ;    4F     O
1FCB:E9          174        byte  $E9 ;    50     P
1FCC:E5          175        byte  $E5 ;    51     Q
1FCD:C5          176        byte  $C5 ;    52     R
1FCE:DA          177        byte  $DA ;    53     S
1FCF:FA          178        byte  $FA ;    54     T
1FD0:CE          179        byte  $CE ;    55     U
1FD1:EE          180        byte  $EE ;    56     V
1FD2:CA          181        byte  $CA ;    57     W
1FD3:EA          182        byte  $EA ;    58     X
1FD4:E6          183        byte  $E6 ;    59     Y
1FD5:C6          184        byte  $C6 ;    5A     Z
1FD6:FF          185        byte  $FF ;    5B     (
1FD7:DF          186        byte  $DF ;    5C     |
1FD8:EF          187        byte  $EF ;    5D     )
1FD9:CF          188        byte  $CF ;    5E     ^
1FDA:FE          189        byte  $FE ;    5F     _
1FDB:E7          190        byte  $E7 ;    60     `
1FDC:7C          191        byte  $7C ;    61     a
1FDD:58          192        byte  $58 ;    62     b
1FDE:78          193        byte  $78 ;    63     c
1FDF:4C          194        byte  $4C ;    64     d
1FE0:6C          195        byte  $6C ;    65     e
1FE1:48          196        byte  $48 ;    66     f
1FE2:68          197        byte  $68 ;    67     g
1FE3:64          198        byte  $64 ;    68     h
1FE4:44          199        byte  $44 ;    69     i
1FE5:7D          200        byte  $7D ;    6A     j
1FE6:59          201        byte  $59 ;    6B     k
1FE7:79          202        byte  $79 ;    6C     l
1FE8:4D          203        byte  $4D ;    6D     m
1FE9:6D          204        byte  $6D ;    6E     n
1FEA:49          205        byte  $49 ;    6F     o
1FEB:69          206        byte  $69 ;    70     p
1FEC:65          207        byte  $65 ;    71     q
1FED:45          208        byte  $45 ;    72     r
1FEE:5A          209        byte  $5A ;    73     s
1FEF:7A          210        byte  $7A ;    74     t
1FF0:4E          211        byte  $4E ;    75     u
1FF1:6E          212        byte  $6E ;    76     v
1FF2:4A          213        byte  $4A ;    77     w
1FF3:6A          214        byte  $6A ;    78     x
1FF4:66          215        byte  $66 ;    79     y
```

```
reference name table

                      value
name      size      dec   hex
ASCII        2     8190  1FFE
CKLF         2     7965  1F1D
CRflag       2     8189  1FFD
Char2        2     8045  1F6D
CharOut      2     8048  1F70
Codes        2     8092  1F9C
Delay1       2     8059  1F7B
Delay2       2     8075  1F8B
GetCode      2     7989  1F35
LCchar       2     8015  1F4F
Linefeed     2     7981  1F2D
Out1         2     8034  1F62
Out2         2     8036  1F64
PAD          2    43008  A800
PADD         2    43010  A802
Return       2     8083  1F93
SFTflag      2     8187  1FFB
Start        2     7904  1EE0
TOUT         2    35488  8AA0
Temp         2     8188  1FFC
Timer        2    42007  A417
Type         2     7916  1EEC
TypeOn       2     8191  1FFF
Xspace       2     7961  1F19
```

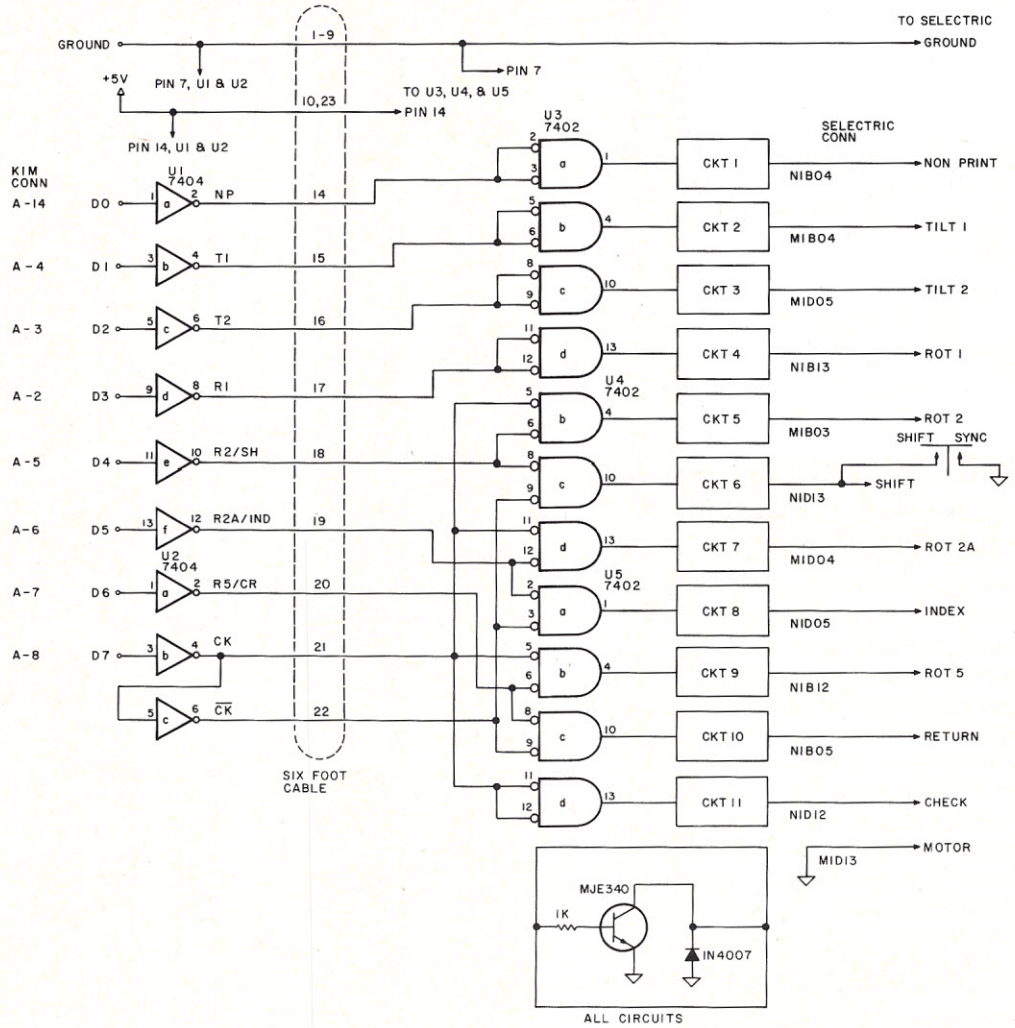


Fig. 1. The complete hardware interface schematic.

Those familiar with the SYM may have already noticed that the program is located from $1EE4 to $1FFF, which would only be available if the SYM had a full 8K of RAM. Or you may have noticed that the Synertek logo and name have been covered up with another added board that has DIP plugs connected to the sockets for the SYM's U12 and U19. If so, you are right!

This little board does expand the SYM to a full 8K of RAM. It is double-sided and requires plated through holes. Hidden jumpers run to pins of SYM's U1 to complete the required connections. The original SYM U12 and U19 plus eight more 2114s mount on this expansion board. The full 8K allows fairly extensive BASIC, Tiny BASIC or assembly-language programs to be used before the SYM runs out of memory space.

To expand memory beyond 8K would definitely require buffering such as used on the memory board in the abovementioned *Microcomputing* article. This little board does not have room for the buffer ICs dictated by good engineering practices. However, many of them are in use on SYMs other than mine without any reported problems.

Since the SYM vectors all of its inputs and outputs through a common memory location in its system RAM, interfacing BASIC or other application programs to the Selectric driver software is easy—just change the vector! Instructions for doing this are contained in the comments of Listing 2.

Conclusion

It is not difficult to interface an IBM Selectric I/O typewriter to a microcomputer, such as the KIM-1 and SYM-1, that has an eight-bit output port and an onboard timer. Excellent, although somewhat slow, print quality is obtainable with minimal hardware and software required. The KIM or SYM can now be used for those applications such as text editing that require hard copy. (The KIM was used to prepare this article.) It helps to have a hard-copy listing of those programs you're trying to debug, too! ■

Notes

Blank PC boards and instructions to expand the SYM to 8K of RAM are available from the author for $5 each plus a self-addressed stamped envelope. KIM-format cassette tapes of the Selectric interface software (specify version) will be provided for $2.50.

Soroc 120 . . . . . $790
Soroc 140 . . . . . $1260
Hazeltine 1400 . . . . . $685
Hazeltine 1410 . . . . . $780
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Intertube $764
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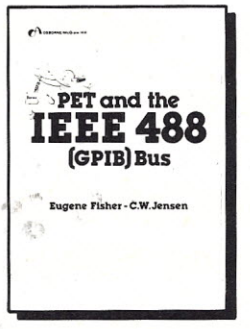
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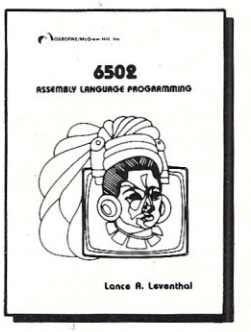
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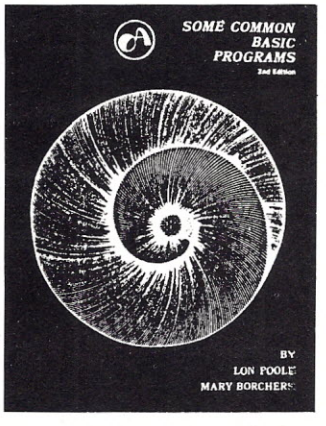


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Understanding Microprocessors with Heathkit's Educational Series

A unit-by-unit look at computer-assisted computer instruction from Heath.

Elliott S. Kanter
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If you stop to think about it, there is little happening today that does not, in some manner, depend on a computer or a microprocessor. In fact—from the controls on our home appliances to sophisticated fuel-injection systems on our cars, and even to digital watches on our wrists—we have entered the age of the computer in full-blown fashion.

The influence on our lives has reached a point where, theoretically, we will be raising a generation unaware of the terms clockwise and counterclockwise, because most, if not all, of us are already wearing digital watches and have at least one digital clock in our homes. Consider the impact and the need to rewrite instructions referring to directions as to the right or to the left, instead of the more familiar clockwise and counterclockwise.

What this all means is that computers and their smaller cousins, the microprocessors, are here to stay, and, as electronic hobbyists, we are going to be the first to recognize their importance to our lives and hobby as well as being in the front lines of their exploitation.

But, before we can use or exploit anything, we must have some firm, basic knowledge about what it is, how it does what it does, and only then can we make it do what we want it to! Which, in essence, puts us at the beginning and looking for some direction in which to go.

Do-It-Yourself Education

No doubt there are some readers who are enrolled in colleges with access to high-powered computers and can take courses in their use and operation as part and parcel of their college program. But, what happens to Mr. "Joe Average" who needs this information and needs to update his knowledge, perhaps to keep the job he now has, or to better himself.

We could tell Joe to go out and buy one of the many computers, either in kit form or assembled, and sit there and play with it until he knows all there is to know. Or, Joe can elect to take some time, spend a few bucks and get some good basic training together with some simple hardware to help him understand what is happening around him in the growing computer marketplace.

Naturally, Joe faces some constraints; he is working, supporting a wife and perhaps a few kids. He can't spend a megabuck, nor can he take time off from work. This leaves home study as the only viable alternative, that is, assuming he doesn't have a maiden aunt who has a hobby of subsidizing her relations.

Home-study, or correspondence school, has had more than its share of undeserved hard knocks. Normally, a home-study program is just that: a structured system in which you invest x number of hours, study 2-x number of small, easy-to-digest bits of information and arrive at point c, the completion of the program and the assimilation of knowledge of a subject that, heretofore, you had little or no acquaintanceship with.

In a nutshell, that's the theory, but, in reality, the practice seems to differ greatly. A large portion of this difference has to do with the various ways that we learn something; we can either learn passively or actively. In the passive mode, you are reading this article, which is telling you things that you may or may not have known before, but it does not require that you take any action other than to relax and read. Television is much the same way—lean back and absorb; you don't need to get involved. The other way we can learn is in the active mode, where we both read or hear something and then are directed to do something with what we have just learned. Courses that offer both classroom and lab periods are active types of educational experiences. Programmed instruction is also the active method of learning, set up in a manner for home-study. Basically, that is what Heathkit's Continuing Education Series is all about.

While there are many programs that you can select, beginning at literally the beginning and upwards through and including computers and programming, all of these share the active mode—you read, you answer and you complete a system of learning. The course we will examine here, Microprocessors and the Microprocessor Trainer is no different; it literally bombards you on a three-dimensional basis: sound (audio cassettes) sight (flip charts or optional slides) and text, all in a package that weighs about 25 pounds and retails at $11.20 per pound ($279.95).

Textbook Instruction

The complete program consists of two massive ring binders, two audio cassettes, a flip chart and ten sections of text, a kit of parts, the Microprocessor Trainer, a second kit based on the popular 6800 chip and expandable at a later date to nearly a full-blown system with the addition of a terminal unit and a small add-on package with more memory.

Reading through the literature before getting under way, I also learned that I would need the use of a TVM or VTVM and an oscilloscope. But remember, in order to get the full benefit out of this course, you *must* have the Microprocessor Trainer and, to assemble it, the usual assortment of hand tools and a small-tip, low-wattage soldering iron. After assembling all of the materials and indexing them into the binders, I plugged in the tape recorder, inserted the cassette and leaned back to learn.

The training program is divided into ten separate units with a total of nine interfacing experi-

ments.

Unit one—*Number Systems and Codes* provides the foundation in the basic concepts of decimal, binary, octal and hexadecimal number systems, conversions, binary codes and positional notation.

Unit two—*Microcomputer Basics* explores terms and conventions, computer words, executing a program and addressing.

Unit three—*Computer Arithmetic* begins with binary addition, subtraction, multiplication and division. Also covered are two's complement arithmetic, Boolean operations—AND, OR exclusive OR and INVERT.

Unit four—*Introduction to Programming* discusses and explains branching, conditional branching, algorithms and additional instructions.

Unit five—*The 6800 Microprocessor, Part 1,* introduces us to the architecture, the instruction set and the addressing modes of this popular chip.

Unit six—*The 6800 Microprocessor, Part 2,* continues with stack operations, subroutines, input/output (I/O) operations and interrupts.

Unit seven—*Interfacing, Part 1,* introduces interfacing fundamentals such as interfacing with random access memory (RAM) as well as interface techniques with displays.

Unit eight—*Interfacing, Part 2,* continues with techniques of switch interfacing, the peripheral interface adapter (PIA) and details on using the PIA.

Unit nine—*Programming Experiments* covers experiments with binary/decimal, hexadecimal/decimal and straight line programs. Arithmetic, logic instructions, branches and additional instructions, as well as new addressing modes, arithmetic operations, stack operations and subroutines.

Unit ten—*Interfacing Experiments* provides practical hands-on experience through experiments with memory circuitry, clocking, address decoding, data output, data input, using the PIA, audio output, key matrix, as well as experiments in parallel-to-serial conversion, digital-to-analog and analog-to-digital conversion techniques.

Essentially, this short-form index describes the course, which is really ten different courses in one. As the audio tape says at the beginning, a firm background in digital circuits and techniques is a must; if you are weak in this area, you are referred to yet another Heathkit Continuing Education Series, "Digital Techniques," which will provide the groundwork for getting the most out of this course on microprocessor technology.

The course itself includes a total of 62 components that are used in conjunction with the trainer to carry out the experiments and proved to be useful in reacquainting me with some of the newer developments, such as breadboard devices for ICs and microprocessor chips.

Assembly of the trainer is a tried and true Heathkit original. It is no harder or simpler than any other kit I have assembled. However, it was a great deal more interesting, considering my basic orientation was to communications-related devices. I have yet to complete all of the possible experiments listed with both manuals because I am having too much fun and pleasure learning from a company and via a training system that challenges, instructs and even entertains me. I have played the cassettes while driving, relaxing in bed and in literally every location and time imaginable.

Student Evaluation

Did the system of instruction work for me? The answer is an unqualifiable yes!

What's next? Simple, according to my catalog: the acquisition of the new Microcprocessor Trainer Accessory, which provides additional I/O and memory expansion for the basic trainer as well as an audio cassette interface. Should I elect to spring for an optional 3K chip set, I will be able to expand the memory to 4K. And then if I add a terminal I've got a "Kanter Kustom Komputer."

What worked for me can and will work for you. Heath has a long and enviable track record of teaching and providing only quality electronic components. If you allow yourself to become involved in the program of instruction, you can't miss. It's painless and, as I mentioned earlier in the article, tax deductible, providing that Treasury Regulation 162-5's provisions are met. This regulation permits an income tax deduction for educational expenses undertaken to: (1) maintain or improve skills required by one's employment or other trade or business, or (2) meet express requirements of an employer or law imposed as a condition for retention of employment, job status or rate of compensation.

Additionally, you will receive, assuming you have scored 70 percent or better on the optional final exam, a certificate of achievement and 8.0 continuing educational units (CEU). The CEU is now a nationally recognized way of acknowledging participation in noncredit adult education and may even be convertible to college-level credits under the CARE (credit for academically related experiences) program in use in many state and community colleges.

In closing, never has so much knowledge been imparted to me by so many and, at the same time, actually been fun! The Heathkit Series EE-3401 Microprocessor and ET-3400 are a good buy for the expanding computer-assisted marketplace and a must on the bookshelves of the serious computer enthusiast. ■

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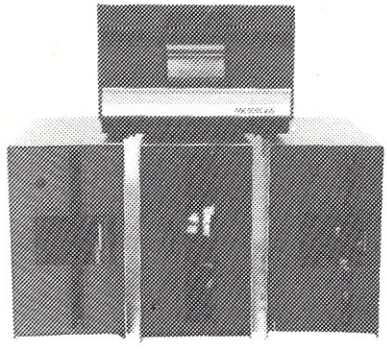
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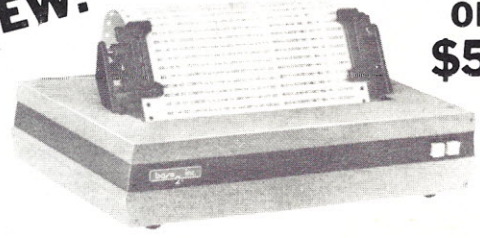
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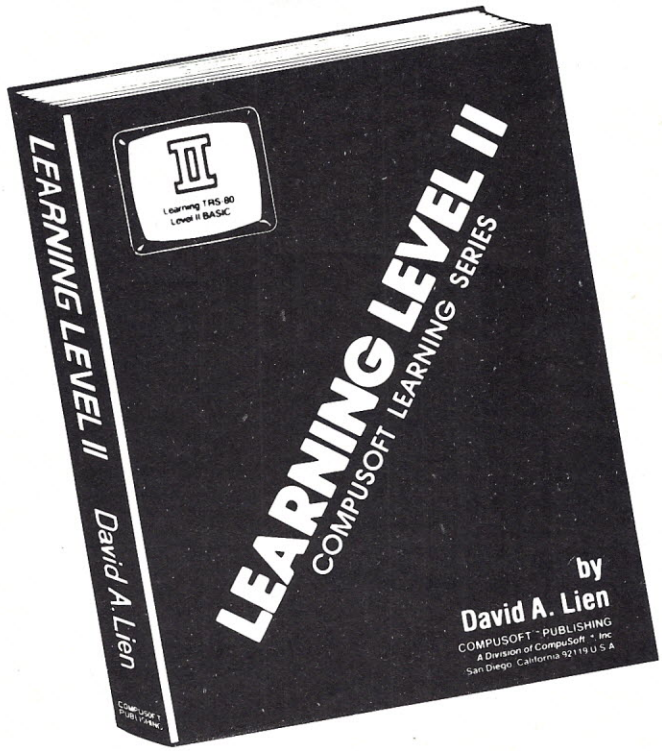
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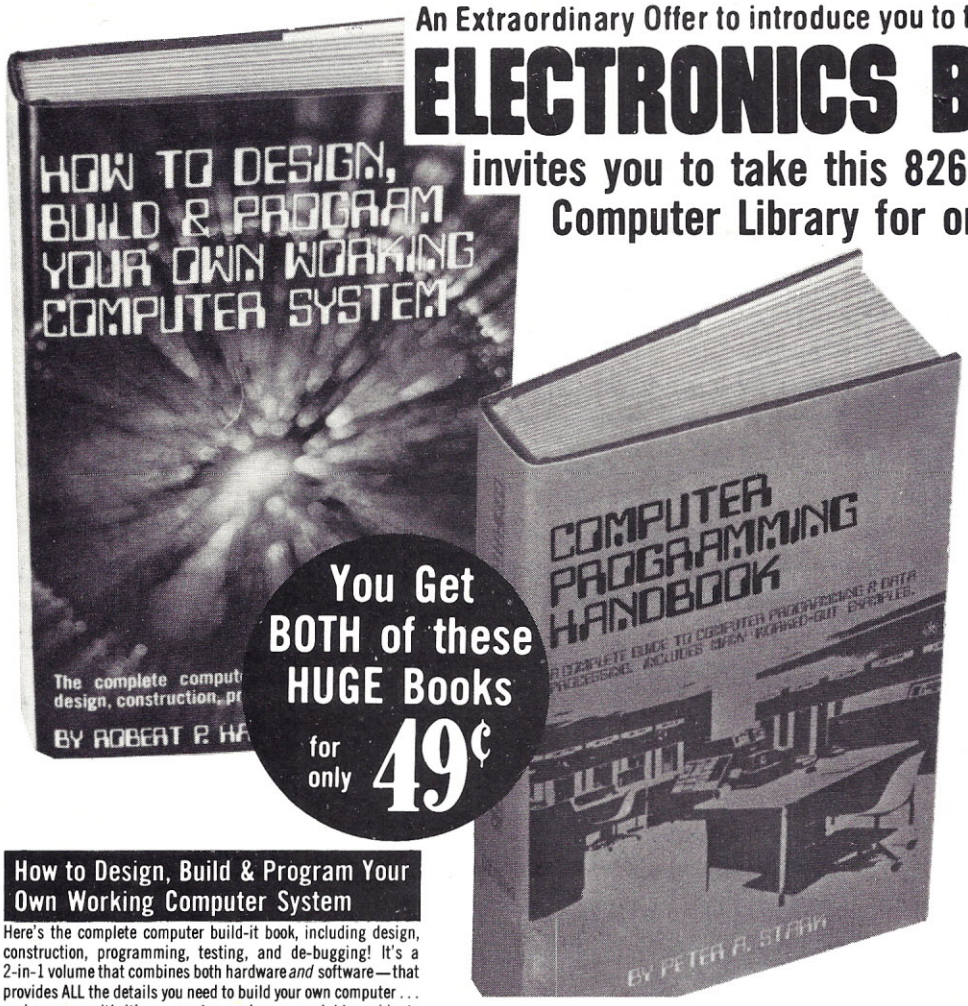
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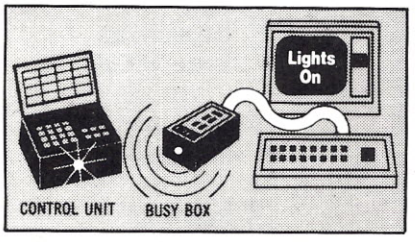
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✓ Reader Service index—page 241

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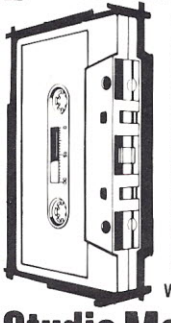
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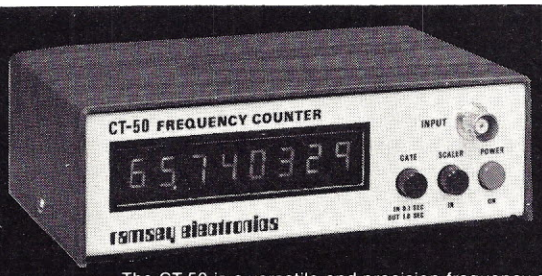
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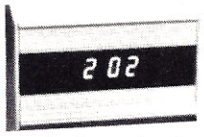
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A First Look at FORTRAN

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I have noticed that people say that they want to learn, but are afraid to try because either they may fail or they just don't know enough to become involved with learning. The same applies to authors (such as me) who try to write their first article.

Some people believe that BASIC is a difficult language to program in. Well, that is just about as false as it can be, at least for the majority of the people who actually use BASIC.

What about FORTRAN? FORTRAN is much like BASIC. It does, however, have a complex, but highly versatile, method of input/output. If you already use BASIC, then FORTRAN should be a snap! First of all, FORTRAN is an acronym for FORmula TRANslator. It is a scientific language, but does lend itself easily to business applications. This article is intended to show those who use BASIC the similarities in the two and to show those interested in FORTRAN exactly what they are interested in.

The Basics of FORTRAN

In most FORTRAN compilers, a FORTRAN statement is entered in a rigid format. The statement must start in a specific column. Other columns are reserved for statement numbers. A "c" placed in column 1 causes that line of input to be used as comments or remarks. One column is usually reserved to indicate whether or not a statement is continued from the previous line. Multiple statements per line are not allowed.

Statement numbers are not required on some statements and are prohibited on others. In this case, the columns reserved for statement numbers are left blank. Only statements to which control will be given by a branching statement require statement numbers. Statement numbers must be non-signed integers and may be either right or left justified.

FORTRAN supports arithmetic statements almost identical to BASIC's, expect that FORTRAN has two kinds of arithmetic variables, integer and floating point. Any variable starting with the letter I-N is automatically designated as an integer variable. Any variable beginning with any other alphabetic character (A-H, O-Z) is designated as floating point.

Variables must begin with an alphabetic character and may contain numbers, but they must not contain a special character or a blank. A variable name may begin with an incorrectly designated letter if it is modified by means of the REAL and INTEGER statements:

```
REAL MAN,NERD
```

MAN and NERD will be floating-point variables, even though they begin with letters that indicate that they should be integer variables.

In the example INTEGER XYZ, ALPHA, XYZ and ALPHA will be integer variables. Notice that it would be an error to write:

```
REAL BAY
```

because any variable name beginning with a B is already automatically designated as floating point.

Most FORTRANs accept at least five character variable names. Also, note that a variable name Z123 is not an array element, but is a single name. An element of array Z123 would be Z123(9), the ninth element. Fig. 1 shows examples of valid and invalid variable names.

Arithmetic expressions may be written with integer or floating point or even both, if done properly. The left side of the expression must be one variable, either integer or floating point. The right side can be several variables, either integer or floating point, but not both, separated by operators.

In the expression ALPHA = B + CAN, B and CAN are added in floating point and stored in floating point as ALPHA. In NUT = B + CAN, B and CAN are added in floating point and stored in integer as NUT. If these two statements were actually executed in a program where B = 6.8 and CAN = 4.1, then ALPHA = 10.9, but only the integer portion of the result can be stored in the integer variable NUT, so NUT = 10.

Floating-point and integer variables may not be used together on the right side unless a subfunction is used to convert the variable. In ALPHA = NEW + CAN, NEW and CAN cannot be added here because they disagree in mode. NEW is integer and CAN is floating point. There are two ways to fix this error.

1. Add:

```
INTEGER CAN
or
REAL NEW
```

This may not be desirable because CAN will now be integer every time it is used; NEW will now be floating point each time it is used.

2. Rewrite the statement as

```
ALPHA = FLOAT(NEW) + CAN
or
ALPHA = NEW + IFIX(CAN)
```

This changes the mode of the variable in only one citation of the variable. IFIX is a subfunction that returns the integer portion of a floating-point variable, truncating the decimal places, and FLOAT returns the floating point equivalent of an integer variable. Perhaps you see no point in using integer, but the value of having two kinds of arithmetic is that you can use speedy integer where slowly executing floating point is not needed.

Of course, addition (+) is not the only operator available. Subtraction (−), multiplication (*), division (/) and exponentiation (**) are also available. Parentheses are also used. Anything enclosed in parentheses is evaluated first; otherwise, calculation proceeds from left to right. Exponentiation is done before multiplication and division. Multiplication and division are done before addition and subtraction. Try this example: If NEW = 3, X = 4.0, GOSH = 7.5, then what does NUTS equal?

```
NUTS = (FLOAT(NEW*3) +
```

GOSH)**(X/2.)*2.7. The answer is 735.075 and is floating point, but is stored at 735 in the integer variable NUTS. Notice that an integer constant is not the same as a floating-point constant. The integer has no decimal point; the floating point does.

If a GOTO statement is encountered, then control is transferred to the statement number to its right: GOTO 100. Just as in BASIC, control is transferred to statement 100. Statement 100 must be an executable statement. It cannot be a DIMENSION, REAL, INTEGER, LOGICAL, COMMON, DATA, DEFINE FILE or SUBROUTINE. These statements are used only by the compiler program and must not have statement numbers. It cannot be a FORMAT statement either, and there are some restrictions on its use with the DO statement.

Statements

The GOTO may take the following form, which is very useful:

```
GOTO(100,20,7,57,13,2000),KODE
```

KODE may be any integer variable. If KODE is 1 then control transfers to statement 100. If KODE is 6 then control transfers to statement 2000. In this case KODE must not exceed 6, and it may never be less than 1. This is similar to BASIC's ON . . . GOTO.

The DATA statement is not like BASIC's DATA statement. This statement is used to initialize variables. In DATA XYZ, ZAP,JUMP/2*0.,0/, all three variables are set to zero. Two floating-point zeros (0.) were assigned to XYZ and ZAP. An integer zero (0) was assigned to JUMP. The assigned values could have been values other than zero. Only the number of values and the mode must be the same as the variables.

Remember that the DATA statement is not an executable statement. If a variable must be reinitialized during the program run, an arithmetic expression is used. In JUMP = 0 or XYZ = 3, note that 3 is integer, but because it is stored in a floating-point variable, XYZ is 3.0.

The DATA statement is extremely useful in initializing arrays, which are handled similarly to BASIC.

The DIMENSION statement sets aside memory for an array:

```
DIMENSION HELP(50),NOWAY(10,5,6)
```

HELP is set aside 50 variable locations. NOWAY is set aside 300 variable locations. One, two and three dimension arrays are allowed. Dimensioning by a variable, as in DIMENSION HELP(X), is allowed only in a subroutine program. To initialize array NOWAY to where all positions are 1, we would write: DATA NOWAY/300*1/

If reinitialization is needed, the DO statement is the most effective method. If you have ever used BASIC's FOR/NEXT statement, then FORTRAN's DO ought to be easy:

Floating Point		Integer	
Valid	Invalid	Valid	Invalid
ALPHA	A#B	IXYZ	XYZ
Z123	A?DL	NEW	REAL
ZAP	2AC	N234	Z123
WOW	MAN	MAN	2JUNK
XM33	R$S	JUNK5	$NOP

Fig. 1. Valid and invalid variable names.

```
DO 100 KMA = 1,50,2
```

Basically, this tells us to do all the statements between this one and statement number 100, including statement 100, as the variable KMA goes from 1 to 50, stepping or incrementing KMA by 2 each time through the loop. The index values must not be floating point. They may be either integer constants or variables. The index must not start at zero, and no arithmetic expressions are allowed. As you can see, the DO statement is not as liberal as the FOR/NEXT statement.

The last statement in the DO range must be executable and must not be a transfer statement. If this condition is not naturally met, then a dummy statement is used:

```
100  CONTINUE
```

A transfer to outside the DO range satisfies the DO statement, and iteration ceases. A transfer into the DO range from outside the DO range is prohibited. DO statements may be nested:

```
      DO 50 J = 1,6
      DO 50 K = 1,5
      DO 50 L = 1,10
50    NOWAY (L,K,J) = 1
```

Every element of NOWAY is set to 1. If the increment in a DO statement is not specified, it is assumed to be one and can be omitted.

So far, FORTRAN seems an awful lot like BASIC. The IF statements are similar, also; but there are two kinds of IF statements, the arithmetic IF and the logical IF. The logical IF is most like BASICs':

```
IF(GOSH.LE.7.)GOTO 10
GOTO 50
```

If GOSH is less than or equal to 7.0, then the true statement will execute and control will go to statement 10. If the logical expression is not true, the false statement GOTO 50 will execute.

GOTO statements are not the only possible true or false statements allowed. Any executable statement can replace either GOTO. The logical operators are surrounded by periods. (The 7 is followed by a decimal point because it is a floating-point constant.) Other operators are .LT.(less than), .GT.(greater than), .GE.(greater than or equal), .EQ.(equal), .OR. and .AND.

The arithmetic IF is less versatile. It evaluates an arithmetic expression and transfers control according to the sign of the result:

```
IF(GOSH – 7.)10,20,30
```

If the arithmetic expression is evaluated as negative, control transfers to statement number 10; if zero, control goes to statement 20; if the result is positive, then control shifts to statement 30. The arithmetic expression can be as complicated as you like. It must conform to the arithmetic rules, though. Simply, in other words, the above example says that if GOSH is less than 7.0, then go to statement 10; if GOSH is equal to 7.0, then go to statement 20; and if GOSH is greater than 7.0, then go to statement 30.

Input/Output

In FORTRAN, peripheral devices are assigned logical device numbers. If you suppose that your FORTRAN compiler has a printer assigned to logical device 1, then you could cite that device as the recipient of output.

The WRITE(1,35)OHBOY,-JUNK,EXPO statement says to write on device 1, using the specifications in statement 35 (which must be a FORMAT statement), the three variables listed. The FORMAT statement describes where to write the variables (OHBOY, JUNK and EXPO) and how they should appear. It is probably the most versatile statement in the FORTRAN language. The simplest format to write the above three variables is to write them on the same line with no spaces between them. Since we have three variables, the FORMAT statement contains three specifications:

```
35  FORMAT(F5.2,I3,F7.2).
```

The three specifications are separated by commas. The letter that begins each specification indicates the type of variable we are going to print: F stands for floating point, and I stands for integer. Since we want to print two floating-point variables (OHBOY and EXPO) and one integer variable (JUNK), the FORMAT statement contains two F specifications and one I specification.

For the F specifications, the number immediately following the letter designates the total number of print positions allocated to the variable. A negative sign or decimal point requires one print position and so must be taken into account when selecting the size of the print field. The number following the "point" indicates the number of decimal places that will be printed. If the variable has more decimal places than called for by the specification, the FORTRAN compiler will delete or "truncate" the excess digits.

In the example, the specification for OHBOY is F5.2, which indicates that the value of OHBOY will occupy five print positions, with two of them to the right of the decimal point. Thus, the F5.2 specification can be used if OHBOY = 18.78, since

18.78 occupies five print positions (remember, you must count the decimal point as one position) and two of the positions are to the right of the decimal point.

The compiler would also accept 18.789 as a proper value for OHBOY, although it will print out as 18.78. The compiler will have truncated the 9 because we specified only two positions to the right of the decimal point. If OHBOY = −18.78, we have a problem, since −18.78 occupies more than five print positions. The compiler cannot truncate any of the digits to the right of the decimal point because we have instructed it to allow two digits there. An error message would result.

In the I specification, the number after the letter again designates the total number of print positions allocated to a variable. Any attempt to print a value for JUNK that is more than three characters long using the I3 specification will result in an error. Thus, using the I3 specification, we could print the integer 476, but not 3476; the latter contains more than three characters. The compiler would accept −69, but not −469 because it contains more than three characters. If we changed the specification to I4, then −469 becomes an acceptable value for JUNK.

To make the example output easier to read, the X specification can be used to put blank spaces between variables:

```
35  FORMAT(10X,F5.2,25X,I3,15X,F7.2)
```

Now our line of output is printed as: ten blank spaces, value of OHBOY, 25 blanks, value of JUNK, 15 blanks, value of EXPO.

If we want the output on more than one line, the / specification is used:

```
35  FORMAT(10X,F5.2,/,I3,15X,F7.2)
```

The / causes a carriage return and line feed, so this FORMAT statement places OHBOY on the first line, with JUNK and EXPO on the next line.

FORTRAN's READ statement also requires a FORMAT statement. A typical READ statement is: READ(2,60)KRUD,ABC, which says to READ from device 2, using the specifications in statement 60 (must be a FORMAT statement), the two variables, KRUD and ABC. The device 2 mentioned above might be a floppy-disk unit, punch card reader, etc. The data on the disk or cards must be arranged according to the FORMAT in statement 60, which might look like this:

```
60  FORMAT(I4,10X,F6.1)
```

This statement defines KRUD as a four-character integer and ABC as a six-character floating-point number with one digit to the right of the decimal point. The data is stored with ten blank spaces between the numbers.

The use of FORMAT statements may seem complex and confusing at first. Indeed, we haven't even considered several other types of specifications that can appear in FORMAT statements. However, once the use of FORMAT statements is mastered, the output of a program can be defined with extreme precision and flexibility. Tables, charts and columns of figures are easily arranged and aligned exactly as desired.

```
      WRITE(1,2)
    2 FORMAT('HOW MANY? (MAX 200 - ENTER IN I3)')
      READ(2,4)NUM
    4 FORMAT(I3)
      WRITE(1,3)NUM
    3 FORMAT('ENTER',1X,I3,1X,'ALPHANUMERIC STRINGS,'
     1 20 CHARACTERS MAX LENGTH, ONE STRING PER LINE')
      DO 1002 J = 1,NUM
 1002 READ(2,1)(ALPHA(J,I),I = 1,20)
    1 FORMAT(20A1)
      CALL SORT(ALPHA,20,NUM)
      WRITE(1,6)
    6 FORMAT(4(/))
      DO 5 J = 1,NUM
    5 WRITE(1,1)(ALPHA(J,I),I = 1,20)
      STOP
      END
RUN

HOW MANY? (MAX 200 - ENTER IN I3)
5
ENTER 5 ALPHANUMERIC STRINGS, 20 CHARACTERS MAX LENGTH, ONE STRING PER LINE
SMITH, JOHN C.
SMITHE, GEORGE
SMITH, JOHN ABE
SMITH & JONES
SMITH, JAMES


SMITH & JONES
SMITH, JAMES
SMITH, JOHN ABE
SMITH, JOHN C.
SMITHE, GEORGE
```

Sample FORTRAN program and run. User inputs are underlined.

FORTRAN's Functions

In the expression SQRT(VOX), the square root of VOX will be evaluated, and that value will replace the function. A function may be cited almost anywhere that a variable can be used. Depending on the FORTRAN compiler, there can be many built-in functions, or the user may define his own. The function's first letter determines whether the function returns a floating point or an integer value. Remember IFIX and FLOAT?

The function is compiled as a separate subprogram. The argument may be several variables; but only one value, set in the function subprogram as a variable with the same name as the function, will be returned. A function that requires only one line or less to be defined may be defined in the main program and is called a function statement.

Want to get back more than one variable? Use a subroutine. The subroutine is compiled as a separate program that has the following as its first statement:

```
SUBROUTINE ALPHA(AX,B,K,INC)
```

ALPHA is the name given to the subroutine. The variables in parentheses, or arguments, are representative of the variables to be shared by the main program and the subroutine. The subroutine program must end with the RETURN statement.

To use the subroutine, the CALL statement is inserted in the main program:

```
CALL ALPHA(X,Y1,I,M)
```

ALPHA is again the subroutine name. The variables in parentheses (X,Y1,I,M) represent the numbers that the main program is sending to subroutine ALPHA for processing. Inside the subroutine, these variables will be labeled AX, B, K and INC. Notice that the variable names in the SUBROUTINE and CALL statements do not have to be the same, although they must agree in mode (floating point or integer).

If many variables are to be transferred each time the subroutine is called, then you may want to use the COMMON statement, which allows several variables to be available to several subprograms. The COMMON statement is placed in the beginning of both programs that will share the variables.

There seems to be a nasty rumor going around that FORTRAN cannot manipulate al-

phanumeric data . . . not so! Alphanumeric strings can be stored in integer arrays; these arrays can be manipulated easily with FORTRAN statements. Alphanumeric data can also be stored in floating-point form, but the manipulation of this data may not be easy!

The Program

The short program asks the user to enter the number of strings that he intends to enter, gives instructions as to how to enter the information, accepts the data, then calls a subroutine named SORT. Note that an integer constant is transferred as an argument. Statement number 1, FORMAT (20A1), may have thrown you. ALPHA is dimensioned here, instead of in a DIMENSION statement, because a variable must be dimensioned the first time it is used; and type statements, such as INTEGER or REAL, must precede the DIMENSION statement.

Also, note that statement number three is continued on the next line. That's why there's a 1 in the column between where the statement number is supposed to be and where the statement begins. Note that the STOP statement is the logical end of the program and the END statement is the physical end. There is also a PAUSE statement, which allows the program to be halted and then resume execution where it stopped.

Files

FORTRAN's or any other high-level language's most important asset is its ability to use random access bulk storage in the form of files. Disk or magnetic tape files are given numbers cited in a READ or WRITE statement. The simplest and most efficient type of file is the unformatted file. The data is stored on the file exactly as it appears in memory, and a FORMAT statement is not used.

A file must be defined first:

```
DEFINE FILE 35(300,56,U,MSTY)
```

File number 35 might be a customer-transaction file. The file contains 300 records, each record being 56 computer words in length. Any combination of variables that will fit in 56 words can be put in each record.

You may have quickly noticed that this file will require 16,800 bytes. You may require more area, depending on the disk operating system. The U indicates that this file is unformatted. An F would cause the output or input of a record from the file to be handled similarly to printed output or input and a FORMAT statement is necessary. The variable MSTY is designated here as a variable, which is automatically incremented by one each time a record is read or written to file 35.

The statement READ(35'25) DATA,NOSE reads two variables, DATA and NOSE, from the 25th record of file 35. If floating-point variables require five words to store in memory, then DATA will be the first five words of the record. NOSE could be an integer array containing alphanumeric data. If the array NOSE required 20 words as defined by its DIMENSION statement, then words six through 25 would be read as array NOSE. The remaining words in the record would be ignored even though they contain data.

Formatted records are accessed with the same type of READ or WRITE statements, except that a FORMAT statement is cited:

```
WRITE(5'NTH,25)WER,X,OUT
```

The NTH record of file number 5 will be written using the FORMAT statement numbered 25.

There is also a FIND statement, which causes the disk system to position the head, so as to minimize seek time during a READ or WRITE to a file. The REWIND statement places the head at the beginning of a file or rewinds a mag tape.

This article in no way claims to be a complete guide to FORTRAN, since no mention of NAMELIST or many other useful statements was made. Also, there are many other ways to use features of the statements mentioned, more than I could ever fit into an article intended to whet your appetite for FORTRAN. ■

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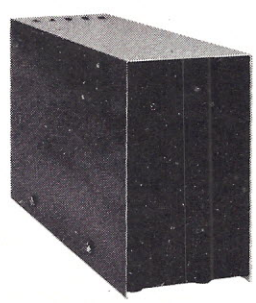
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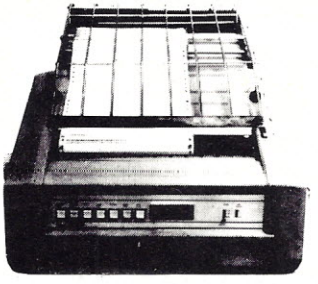
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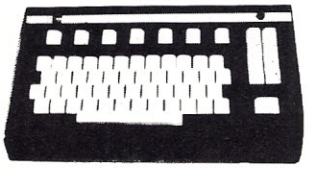
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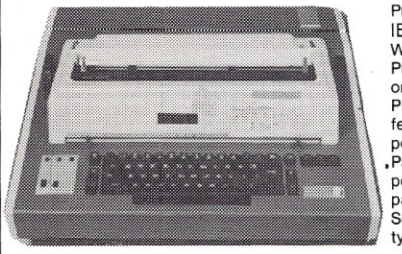


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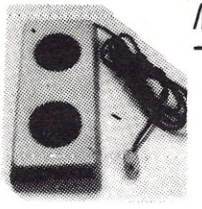
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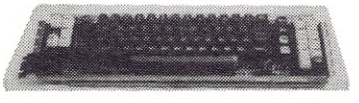
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V 5, 16.5, 6, -3
A 12, 6, 2, 1

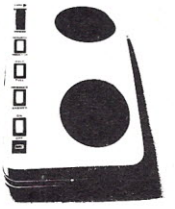


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V 5, 12, -12
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We now take Master Charge and Visa orders. Specify full number, bank number and expiration date.

✓ Reader Service index—page 241

NEECO

Microcomputer Systems Division

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*The 16K/32K (large keyboard) units do not include a cassette drive. Order C2N Cassette. 2040 Floppy Drive requires a 16K or 32K unit. 8K RAM Retrofit available July.

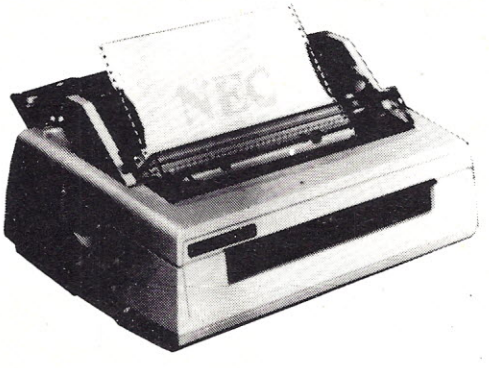
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*The CMS Software (G/L, A/R, A/P) are based on Osborne & Associates trial tested business basic software. Software is complete with full documentation and user instructions. All packages require a printer for output. Commodore recommends the NEC Spinwriter (available from NEECO) as the output printer for WORDPRO.

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*The NEC 5530-P is the output printer recommended by Commodore for their Word Processing System.

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$$$$—WANTED—TRS-80s—WANTED—$$$$ Any quantity, any condition, immediate cash available. Used TRS-80s and peripherals available. Write for firm cash offer. Also used DEC PDP8, 11 CPUs, peripherals. Jim Simpson, Box 632, W. Caldwell NJ 07006. Tel. eves. (201) 226-9185.

SYM-1 single-board microcomputer in original box with all manuals. 1K version. $150. Mr. V. M. Faulkner, RR #2 Box 294A, Yorktown IN 47396. (317) 289-4138.

Digital Group Z-80 w/10K, I/O, TVC-64, monitor, keyboard plus extras. All in DG cabinets. $700. Paul Mayo, 2409 Ocean Pkway, Brooklyn NY 11235. (212) 646-7725.

For Sale: 2 GE Terminet 30/80 column. 1 GE Terminet 30/132 column. All have internal modems and stands. Good working order. Richard Starck, (412) 729-3510.

For Sale: Intel SDK-85 SBC system, completely assembled with extra 8155 RAM I/O and timer chip wired in, instruction book, assembly manual, MCS-85 users manual. Asking $260; you pay shipping. See article in Jan. 79 issue of *Byte*. Also TTY-33 KBD, single 5 V supply, $50. Sam Stickle, 651 E. Travis Blvd. #14, Fairfield CA 94533. (707) 422-4850.

For Sale: Wameco CPU-1 8080 w/8 level interrupt, $80; RTC-1 real-time clock, $85; QM-1 12-slot mother, $55; Tarbell cassette w/lots of software, $95; Microdesign MR-8 EPROM w/RAM, $95; SSM VB-1 video display, $95. All assembled & tested. Removed for system upgrade. (201) 493-8047. A. Beck, 2904 Willow Dr., Ocean NJ 07712.

Expanded KIM: 2 8K RAM boards, 2K EPROM, S-100 motherboard, separate 64 × 16 TVT, fast tape I/O, books, software; all for $400. Fred Monsour, 309 Camellia Dr., Charlottesville VA 22903. (804) 977-8077.

KSR-33 Teletype (send/receive) ready for use as a printer for your TRS-80 or computer with RS-232/20 mA port. Yours for $275 with manual, interf. diagr. & softw. Call Ed (516) 724-9417.

Cromemco 3355 impact letter-quality printer. New/never used. Cost $3995. Will sell for $3250 (freight collect). Kenneth Absher, Grass Valley CA 95945. (916) 273-4453.

Comprehensive radiology billing pgm for TRS-80. Handles unlimited no. of accounts. Software operates with 48K mem, 2 drives, line printer. Ages, cycles bills, zip code sorts, prints ins. forms. Search files by name or acct #. Itemized statement, ins. form, correct or add to account anytime. Alpha sort printout for crossfile. Simple 3 letter procedure entry (ivp, ugi, etc.). Billing analysis on screen or printout. Can be adapted to other specialties. Program in use one year and fully debugged. Program for $595. P. J. Palmisano MD. (214) 592-2133.

Apple/ALF music users interested in trading songs contact Gary M. LaPoten, 333 North Palm Drive, Beverly Hills CA 90210.

For Sale: Heathkit H9 video display, $300; H8-5 serial I/O and cassette interface, $50; Godbout 12K static memory, $100. All burned in and working. I have upgraded to H19 and more memory. Write J. Gold, PO Box 2024, Des Moines IA 50310. Or call (515) 279-9821.

Wanted: Schematic or connection data for Clare-Pendar keyboard, code #97564, Assm. #720731-K1, T.I. P/N 959326, Rev E, 7342. Jim Jamison, Rte. 6, 2304 Tucker Lane NE, No. Ft. Myers FL 33903. (813) 997-3010.

Wanted: Altair 8800B mainframe. Send price and list of accessories included and/or also available. J. W. Carlson, Rte. 1, Box 364B, Kingston NY 12401. (914) 336-8297.

Wanted: Software for S-100. Particularly specialized for business data bases and similar applications. Modification programming assistance in NYC metropolitan area is solicited. (212) 867-5650.

For Sale: E & L MMD-1 8080-A micro w/M-1 interface. 2.5K RAM, PROM D-bug, keybd entry, cassette interf., serial I/O. A-1 condition. $395. Don Woods, 12012 Pebblebrook Ln., Carmel IN 46032. Tel: (317) 846-8388.

For Sale: Quitting hobby. All test equipment, ICs, transistors, diodes, capacitors, etc. must go. Send SASE for list and prices. Steve Pang, 99-709 Hoio St., Aiea HI 96701.

For Sale: ASR-33 Teletype ($450), KSR-33 Teletype ($375), KSR-35 Teletype ($550), high speed Teletype line printer ($285), high speed Teletype paper punch ($135), call Jim or Jerry evenings (509) 547-8745 or 547-7057.

For Sale: I have 4 Shugart SA400 and 2 Pertec FD200 disk drives. They work great! Will sell for $258 each. 4-drive cable—$20; 2-drive cable—$15. Quickly to Dave Sparks, 5232 Cornell, Westminster CA 92683. (714) 997-7640.

Wanted: TRS-80 Level II 32K tape programs for maintaining all Boy Scout Troop schedules, financial and advancement records with printout for 80-column printer. Send sample printout with program price. Troop #288, Frederick Walter, Treasurer, Box 302, Selden NY 11784. (516) 732-1348.

For Sale: SA-400 Shugart drives with case & pwr. supply, $290 each. Vector EPROM/RAM board with 11 new 1702A EPROMs, $75. North Star disk system (single density) with 1 drive, cable, case, etc., $450. (Same system w/3 drives, DOS for Sol-20, BASIC, etc., $999.) This equipment looks like new and works perfectly! Fred Manthey, Box 619, Mullan ID 83846. (208) 744-1328.

CALENDAR

Baltimore MD

The 1980 Greater Baltimore Hamboree and Computerfest will be held Sunday, March 30, 1980, at the Maryland State Fairgrounds at Timonium. The doors open at 8 AM. Adult admission is $3. Free parking and food service will be provided. The fairgrounds are located just off of I-83, 2 miles north of I-695 near Baltimore. For information or reservations write to Joseph A. Lochte, Jr., 2136 Pine Valley Dr., Timonium MD 21093.

Sarasota FL

Tentative plans are to hold the first West Coast Computer Fair, sponsored by the TRS-80 Users Group of Sarasota, in February or March 1980. We welcome responses from individuals, businesses or educational institutions. If you want a commercial booth, want to give a lecture or demonstration, or require additional information, please contact Carmen A. Gianforte, Program Chairman, 19 North Blvd. of Presidents, Sarasota FL 33577.

Clemson SC

Second Clemson Small Computer Conference: May 21–22, 1980, Clemson University, Clemson SC. Papers are solicited describing applications of small computers. Of particular interest are applications in engineering, science, manufacturing, small business data processing and education. Submit three copies of a 500-word summary by February 1, 1980, with final papers due April 1, 1980, to William J. Barnett, Electrical and Computer Engineering Dept., Riggs Hall, Clemson University, Clemson SC 29631.

Philadelphia PA

The annual PACS Computer Games Festival, sponsored by the Philadelphia Area Computer Society and LaSalle College Physics Department, will be held March 15, 1980, from 10 AM to 6 PM in the LaSalle College Ballroom, 20th & Olney, Philadelphia. For further information, contact Stephen A. Longo, PhD, Physics Dept., La Salle College, Philadelphia PA 19141. (215) 951-1255.

Albion MI

Saturday, March 1, 1980, Albion College will hold a microcomputer fair, "Exploring Small Computers." It is aimed at introducing the uses of microcomputers in education, business, and home/hobby. For more information: David W. Kammer, Chm., Dept. of Physics, Albion College, Albion MI 49224. (517) 629-5511.

Miami Beach FL

Interface '80 is scheduled for the Miami Beach Convention Center, March 17–20, 1980. For information, contact Data Communications, Interface '80, 160 Speen St., Framingham MA 01701. (617) 879-4502. Outside of Massachusetts, call toll free (800) 225-4620.

Notice

PET-pourri will resume in the next issue.

DEALER DIRECTORY

Attention, Hobbyists and Businessmen: This Dealer Directory was created to give exposure to computer and electronics dealers and to help *you* find the sources for equipment, components and services. These dealers are actively looking to supply your needs in the home and business computer market. Call the one nearest you!

Hollywood CA

Largest selection of computer books in the country. Software for the TRS-80, Apple, PET, etc. Magazines. Open Monday–Saturday, 9:30–5:30. **Opamp Technical Books, 1033 No. Sycamore Ave., Los Angeles CA 90038, 464-4322.**

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Featuring: PolyMorphic, North Star, Imsai, Cromemco, Extensys, Speechlab products and Poly-88 Users Group software exchange. All products 10-20% off list. We won't be undersold! **A-A-A-A Discount Computer How's, 1477 Barrington, Suite 17, Los Angeles CA 90025, 477-8478.**

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Systems for business, industry and hobbyist. Five terminals, ten printers and five mainframes on display. Superbrain, Horizon Quad, Compucolor II, Equibox and Altos Computer System with hard disk. Much software incl. CP/M, TRS-80 and PET. **Digital Deli Computer Store, 80 W. El Camino Real, Mt. View CA 94040, 961-2670.**

San Francisco CA

Apple Specialists in business, personal and custom applications. Full line of peripherals, supplies and for leisure; sophisticated electronic games and video games. **A.I.D.S., Inc., Artifical Intelligence Design Specialists, Inc., 301 Baoboa St., San Francisco CA, 221-8500.**

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Business systems, personal systems, whatever the application, we can help. Consulting, programming, education and maintenance. Service, support and professionalism at affordable prices. **Computer Age Inc., 1308 N. Federal Hwy., Pompano Beach FL 33062, 946-4999.**

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Discount prices & professional service: Cromemco, Northstar, Vector Graphic, DEC, TI, Thinker Toys, Intertube, Soroc, Centronics, NEC, Selectric interfaces, Microdasys. Complete business & medical billing software available. MicroAge & Serendipity software discounted. **Sara-Tech Electronics, Inc., Computer Division, PO Box 692, Venice FL 33595, 485-3559.**

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Microcomputer systems for home or business; peripherals, software, books & magazines. Apple, North Star, Cromemco systems. Also TI 910 and the IDS-440 printer w/Apple graphics. **Farnsworth Computer Center, 1891 N. Farnsworth Ave., Aurora IL 60505, 851-3888.**

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Computer Hardware/Software Specialists for home and business. Largest selection of computer books, magazines and copyrighted software in Chicago Metro area. Experienced factory-trained service department. Feature Apple and Alpha Microsystems and accessories. **Data Domain of Schaumburg, 1612 E. Algonquin Road., Schaumburg IL 60195, 397-8700.**

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Computer systems design, programming and consultation by computer experts. Dealer for SSM, Integrand, Tarbell, Ithaca Intersystems, Verbatim, Diablo and others. Discount prices on many items. **Wilcox Enterprises, 25W178-39th St., Naperville IL 60540, 420-8601.**

Laurel MD

Apple & Exidy Sorcerer. Authorized dealer for both. We also sell subscriptions to "The Source" timeshare service. Plus full line of ham equipment. **The Comm Center, Laurel Plaza, Rte. 198, Laurel MD 20810, 792-0600.**

Garden City MI

Complete systems for business, professional and personal applications. Custom programming available. Apple II, North Star, Vector Graphic and other lines of microcomputers, software, books, components. **Computer Center, 28251 Ford Rd., Garden City MI 48135, 422-2570.**

Grand Rapids MI

Full-line microcomputer store. Ohio Scientific—Equinox—PolyMorphic Systems—Digital Systems—Godbout—Dynabyte—Thinker Toys—Meca—North Star. **Micro Computer World, 313 Michigan St., N.E., Grand Rapids MI 49503, 451-8972.**

St. Louis MO

Experimenters' Paradise. Electronic and mechanical components. Computer People, Audio People, Hams, Robot Builders, Experimenters. Open six days a week. **Gateway Electronics Corp., 8123-25 Page Blvd., St. Louis MO 63130, 427-6116.**

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Computer Software for business and home. TRS-80, Apple, North Star. Also Centronics printers. Discounts available. **Legey and Castillo Associates, 2908 Tahiti Ct. N.E., Albuquerque NM 87112, 298-5734.**

Lynbrook NY

Complete line of business computer hardware, software & service. Design of special software to suit your business. Specialists in systems for truck routing & restaurants. **Long Island Computer General Store, Inc., 103 Atlantic Ave., Lynbrook NY 11563, 887-1500.**

New York NY

Ohio Scientific distributor. Full stock, service and software. Software for PET, Apple, TRS-80 and hobbyist accessories (Jim Pack). **Aristo-Craft Computers, 314 Fifth Ave., Corner 32nd Str., New York NY 10001, 349-9034.**

New York NY

S-100 New York City systems provided for business and office applications. We also seek experienced S-100 programmers on a part-time basis. **Olcott International & Co., PO Box 3014, Weehawken NJ 07087, 867-5650.**

Akron OH

We've got it all. Business systems. Personal systems. Software packages. Custom programming. Terminals. Printers. Service and books. Easy freeway access. 10 AM to 6 PM Monday–Saturday. **The Basic Computer Shop, Fairlawn Plaza, 2671 West Market St., Akron OH 44313, 867-0808.**

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Cromemco. Ohio Scientific. Centronics printers. Hazeltine terminals (CRT). Two-dimensional plotter software for Cromemco, as well as three-dimensional plotter software for Cromemco. Business software. Mon.–Sat. 10–7. **The Micro-Shop, 5686 Dressler Rd., North Canton OH 44720, 497-0847.**

Kingston PA

We support Level II and Model II. Books, magazines, programs, parts, accessories, peripherals, free literature, free seminars, cassettes, floppies, filters, transformers, caps, chips, CRTs. **Artco Electronics, 302 Wyoming Ave., Kingston PA 18704, 287-1014.**

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North Star, fast delivery possible; Heath terminals, Intertube II, immediate delivery. Free video terminal comparison, Intertec's SuperBrain, all Centronics printers, Omnitec data modems/couplers, NCR terminals. **L & S Distributors, 44 So. Locust, Marlton NJ 08053, 983-7444.**

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SS-50 Buss Stop. Business & personal systems: Smoke, SWTP, Gimix, MSI, Exidy, TSC, Computerware, Jim-Pak, ACP, etc. Sales & service. Closed Sunday. **G. Y. C. Co., 51 Hamilton Avenue, York PA 17404, 854-0481.**

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Experimenters' Paradise! Electronic and mechanical components for computer people, audio people, hams, robot builders, experimenters. Open six days a week. **Gateway Electronics, Inc., 8932 Clarkcrest, Houston TX 77063, 978-6575.**

Dealers: Listings are **$15** per month in prepaid quarterly payments, or one yearly payment of **$150**, also prepaid. Ads include 25 words describing your products and services plus your company name, address and phone. (No area codes or merchandise prices, please.) Call Marcia at 603-924-7138 or write *Kilobaud MICROCOMPUTING*, Ad Department, Peterborough NH 03458.

CORRECTIONS

Please note the following correction for the UART schematic for Fig. 1 of my article, "Elfish Ideas," Oct. '79, p. 154. The UART pin where $\overline{\text{TX DEVICE SELECT}}$ comes in is not labeled. It should be marked pin 23, which corresponds to the UART internal signal of $\overline{\text{TBRL}}$ (TX BUFFER LOAD). Thanks to Bill Casmaer for bringing it to my attention.

—Glen A. Popiel—

Somewhere between the corrected proof and the published article, "Have a Ball with Bally," in the November 1979 issue, p. 142, a couple of important program segments were lost. The corrected lines are as follows:

```
270  GOSUB 440; IF G = 1 GOTO 330
280  IF S = 0 R = R + 1; GOTO 330
```

To those who asked for an easier version, substitute the following lines:

```
260  IF X<3 IF X>-3 IF Y<3 IF Y>-3 GOTO 300
440  IF X<4 IF X>-4 IF Y<4 IF Y>-4 A=520; G=1; GOTO 460
```

My thanks to everyone who telephoned and wrote to me. Your compliments were appreciated.

—Richard J. Nitto—

NEW PRODUCTS!

Super Color S-100 Video Kit $99.95
Expandable to 256 x 192 high resolution color graphics. 6847 with all display modes computer controlled. Memory mapped. 1K RAM expandable to 6K. S-100 bus 1802, 8080, 8085, Z80 etc.

Gremlin Color Video Kit $59.95
32 x 16 alpha/numerics and graphics; up to 8 colors with 6847 chip; 1K RAM at E000. Plugs into Super Elf 44 pin bus. Not expandable to high resolution Graphics.

Elf II Adapter Kit $24.50
Plugs into Elf II providing Super Elf 44 and 50 pin bus plus S-100 bus expansion (With Super Expansion). High and low address displays, state and mode LED's optional **$18.00.**

1802 16K Dynamic RAM Kit $149.00
1802/S-100 expandable to 32K, Hidden refresh w/clocks up to 4 MHz w/no wait states Addl. 16K RAM **$79.00.**

Quest Super Basic

Quest, the leader in inexpensive 1802 systems announces another first. Quest is the first company worldwide to ship a **full size Basic** for 1802 systems. A complete function **Super Basic** by **Ron Cenker** including floating point capability with scientific notation (number range $\pm .17E^{38}$), 32 bit integer ± 2 billion; Multi dim arrays; String arrays; String manipulation; Cassette I/O, Save and load, Basic, Data and machine language programs; and over 75 Statements, Functions and Operators.

Easily adaptable on most 1802 systems. Requires 12K RAM minimum for Basic and user programs. Cassette version in stock now. ROM versions coming soon with exchange privilege allowing some credit for cassette version.

Super Basic on Cassette $40.00

Tom Pittman's 1802 Tiny Basic Source listing now available. Find out how Tom Pittman wrote Tiny Basic and how to get the most out of it. Never offered before. $19.00

S-100 4-Slot Expansion $ 9.95

Super Monitor VI.I Source Listing $15.00

Coming Soon: Assembler, Editor, Disassembler, DA/AD, Super Sound/Music, EPROM programmer.



RCA Cosmac Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded** with **additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game.

Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and research and development.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** Expansion Cabinet with room for 4 S-100 boards **$41.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a 12 page monthly software publication for 1802 computer users is available by subscription for $12.00 per year.

Tiny Basic Cassette **$10.00,** on ROM **$38.00,** original Elf kit board **$14.95. 1802 software;** Moews Video Graphics **$3.50.** Games and Music **$3.00,** Chip 8 Interpreter **$5.50.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

A IK Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatible cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. The Super Monitor is written with subroutines allowing users to take advantage of monitor functions simply by calling them up. Improvements and revisions are easily done with the monitor. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake**. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at $15.50 for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply).

P.O. Box 4430S Santa Clara, CA 95054
For will call only: (408) 988-1640
2322 Walsh Ave.

✓Q3

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7400TTL

7400N	.17
7402N	.18
7404N	.19
7409N	.23
7410N	.16
7414N	.70
7420N	.18
7422N	.39
7430N	.20
7442N	.50
7445N	.69
7447N	.60
7448N	.69
7450N	.18
7474N	.35
7475N	.49
7485N	.68
7489N	1.85
7490N	.43
7492N	.43
7493N	.43
7495N	.69
74100N	.90
74107N	.35
74121N	.34
74123N	.59
74125N	.45
74145N	.69
74150N	.95
74151N	.89
74154N	1.00
74157N	.69
74161N	.87
74162N	.87
74163N	.87
74174N	.96
74175N	.90
74190N	1.15
74192N	.87
74193N	.85
74221N	2.00
74298N	1.65
74365N	.66
74366N	.66
74367N	.66

74LS00 TTL

74LS00N	.35
74LS02N	.35
74LS04N	.35
74LS05N	.35
74LS08N	.35
74LS10N	.35
74LS13N	.55
74LS14N	1.10
74LS20N	.35
74LS22N	.35
74LS28N	.41
74LS30N	.35
74LS33N	.75
74LS38N	.55
74LS74N	1.25
74LS75N	1.00
74LS90N	.85
74LS93N	.70
74LS95N	1.10
74LS107N	.45
74LS112N	.45
74LS113N	.35
74LS132N	.89
74LS136N	.45
74LS151N	.85
74LS155N	.85
74LS157N	.85
74LS162N	1.15
74LS163N	1.15
74LS174N	2.00
74LS190N	1.08
74LS221N	1.95
74LS258N	.67
74LS367N	1.35

LINEAR

CA3045	.90
CA3046	1.10
CA3081	1.80
CA3082	1.90
CA3089	2.95
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LM308N	.89
LM309K	1.50
LM311H/N	.90
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LM318	1.35
LM320K-5	1.50
LM323K-5	5.95
LM320K-12	1.50
LM320K-15	1.50
LM320T-5	1.60
LM320T-8	1.60
LM320T-12	1.50
LM320T-15	1.60
LM324N	1.15
LM339N	1.55
LM340K-5	1.35
LM340K-8	1.35
LM340K-12	1.35
LM340K-15	1.35
LM340K-24	1.35
LM340T-5	1.25
LM340T-8	1.25
LM340T-12	1.25
LM340T-15	1.25
LM340T-18	1.25
LM340T-24	1.25
LM343H	4.50
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LM370	1.15
LM377	3.00
LM379	5.00
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LM381	1.60
LM382	1.60
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LM709H	.28
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LM733N	.67
LM741CH	.35
LM741N	.32
LM747H/N	.75
LM748N	.35
LM1303N	1.75
LM1304	1.10
LM1305	1.27
LM1307	2.00
LM1310	2.75
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LM1800	1.75
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LM3905	1.75
LM3909N	.89
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NE550N	1.00
NE555V	.39
NE556A	.85
NE565A	1.00
NE566V	1.50
NE567V	1.00
NE5708	5.00
78L05	.60
78L08	.60
78M05	.85
75108	1.75
75491CN	.50
75492CN	.55
75494CN	.89

A to D CONVERTER

8038B	4.50
8700CJ	13.95
8701CN	22.00
8750CJ	13.95
LD130	9.95
9400CJ/V/F	7.40
ICL7103	9.50
ICL7107	14.25

CMOS

CD3401	Fair. .50
CD4000	.16
CD4001	.28
CD4002	.28
CD4006	1.10
CD4007	.28
CD4008	.28
CD4009	.45
CD4010	.45
CD4011	.28
CD4012	.28
CD4013	.39
CD4014	1.00
CD4015	1.00
CD4016	.45
CD4017	1.05
CD4018	.94
CD4019	.45
CD4020	1.02
CD4021	1.25
CD4022	1.10
CD4023	.28
CD4024	.75
CD4025	.28
CD4026	2.00
CD4027	.66
CD4028	.85
CD4029	1.02
CD4030	.45
CD4035	1.02
CD4040	1.02
CD4042	.85
CD4043	.85
CD4044	.85
CD4046	1.67
CD4047	.45
CD4050	.49
CD4051	1.13
CD4060	1.42
CD4066	.71
CD4068	.40
CD4069	.40
CD4070	.50
CD4071	.28
CD4072	.28
CD4073	.28
CD4075	.28
CD4076	1.45
CD4078	.40
CD4081	.28
CD4082	.28
CD4116	.47
CD4490	5.50
CD4507	1.00
CD4508	4.25
CD4510	1.02
CD4511	.94
CD4515	2.52
CD4516	1.10
CD4518	1.02
CD4520	1.02
CD4527	1.51
CD4528	.79
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CD4585	1.10
CD40192	3.00
74C00	.28
74C04	.40
74C10	.28
74C14	2.10
74C20	.28
74C30	.28
74C48	1.95
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74C90	1.15
74C93	1.40
74C154	3.00
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74C175	1.35
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8095	.65
8096	.65
8097	.65
8098	.65
8T09	1.25
8T10	4.50
8T13	3.00
8T20	5.50
8T23	3.10
8T24	3.50
8T25	3.20
8T26	1.69
8T28	2.75
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8T98	1.69

MOS/MEMORY RAM

2101-1	3.95
2102-1	.95
2102AL-4	1.25
2102AN-2L	1.60
21L02-1	1.18
21F02	1.25
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2111-1	3.75
2112-2	3.95
2114L-1	7.40
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MM5280	3.00
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N82S129	3.75
N82S131	3.75
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N82S137	8.75
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100 pin edge	4.50
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IC SOCKETS

Solder Tin		Low Profile	
PIN	1UP	PIN	1UP
8	.15	22	.30
14	.14	24	.35
16	.16	28	.42
18	.27	36	.58
20	.29	40	.57

2 level 14 pin ww .20

WIRE WRAP LEVEL 3

PIN		PIN	
14	.32	24	.86
16	.33	28	1.00
18	.57	40	1.23

CRYSTALS

1 MHz	4.50
2 MHz	4.50
4 MHz	4.25
5 MHz	4.25
10 MHz	4.25
18 MHz	3.90
20 MHz	3.90
32 MHz	3.90
32768 MHz	4.00
1.8432 MHz	4.50
3.5795 MHz	1.20
2.0100 MHz	1.95
2.097152 MHz	4.50
2.4576 MHz	4.50
3.2768 MHz	4.50
5.0688 MHz	4.50
5.185 MHz	4.50
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6.5536 MHz	4.50
14.31818 MHz	4.25
18.432 MHz	4.50
22.1184 MHz	4.50

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DB25P	2.95
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2N222A	.27
2N2369	.30
2N2904A	.20
2N2907A	.25
2N3053	.40
2N3638	.25
2N3643	.25
2N3904	.18
2N3906	.18
2N3055	.69
2N4400	.25
2N4401	.25
2N4402	.20
TIP31	.60
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10 per type .03 1000 per type .012
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12V CT 250 ma wall plug 3.50
24V CT 400 ma 3.95
10V 1.2 amp wall plug 4.85
12V 6 amp 12.95
12V 500 ma wall plug 4.75
12V 1 amp wall plug 6.50
12V 3 amp wall plug 8.50

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MAN3	CC	.125 .39
MAN72/74	CA/CA	.300 1.00
DL704	CC	.300 1.25
DL707/DL707R	CA	.300 1.00
DL727/728	CA/CC	.500 1.90
DL747/750	CA/CC	.600 1.95
DL750	CC	.600 1.95
FND359	CC	.357 .70
FND500/507	CC/CA	.500 1.35
FND503/510	CC/CA	.500 .90
FND800/807	CC/CA	.800 2.20
3 digit Bubble		.60
4 digit Bubble		.80
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DG10 Fluorescent		1.75
5 digit 14 pin display		1.00
NSN69 9 digit display		.60
7520 Clairex photocells		.39
TIL311 Hex		9.50
MAN3640	CC	.30 1.10
MAN4610	CA	.40 1.20
MAN4640	CC	.40 1.20
MAN4710	CA	.40 .95
MAN4740	CC	.40 1.20
MAN6640	CC	.56 2.95
MAN6710	CA	.60 1.35
MAN6740	CC	.60 1.35
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MA1012A		**8.95**
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6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display, ROM monitor, fully expandable. $375.00. 4K version $450.00. 4K Assembler $85.00, 8K Basic Interpreter $100.00.

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7407	.19	74126	.44
7408	.19	74128	.49
7409	.19	74132	.69
7410	.19	74136	.75
7411	.25	74139	.69
7412	.25	74141	.79
7413	.35	74143	2.75
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7422	.79	74153	.59
7423	.22	74154	.99
7425	.25	74155	.75
7426	.35	74156	1.12
7430	.19	74157	.65
7432	.25	74160	.85
7437	.25	74161	.79
7438	.25	74162	.89
7439	.27	74163	.79
7440	.45	74164	.89
7441	.70	74165	.89
7442	.49	74166	1.29
7443	.59	74170	1.59
7444	.59	74173	.99
7445	.69	74174	.85
7446	.69	74175	.79
7447	.59	74176	.79
7448	.69	74177	.75
7450	.19	74179	1.89
7451	.19	74780	.79
7453	.19	74181	1.89
7454	.19	74182	1.25
7460	.19	74184	1.95
7470	.33	74185	1.95
7472	.28	74190	1.25
7473	.35	74191	1.25
7474	.29	74192	.75
7475	.39	74193	.75
7476	.35	74194	.89
7479	4.75	74195	.69
7480	.49	74196	.89
7481	.99	74197	.89
7482	.99	74198	1.49
7483	.59	74199	1.49
7485	.69	74221	1.45
7486	.35	74251	1.09
7489	1.75	74273	1.10
7490	.39	74278	3.00
7491	.55	74279	.85
7492	.43	74298	.95
7493	.43	74365	.68
7494	.79	74366	.68
7495	.65	74376	.68
7496	.65	74368	.68
7497	2.90	74393	3.25
74100	1.42	8T97	1.65
74107	.29		

74LS

Order by Cat No. 999 and type

NO.	PRICE	NO.	PRICE
74LS00	.28	74LS157	1.45
74LS01	.19	74LS158	.69
74LS02	.29	74LS160	.99
74LS03	.19	74LS161	1.10
74LS04	.89	74LS162	.99
74LS05	.35	74LS163	.99
74LS08	.29	74LS164	1.25
74LS09	.25	74LS165	.89
74LS10	.29	74LS168	.99
74LS11	.59	74LS169	.99
74LS12	.29	74LS170	1.69
74LS13	.59	74LS173	1.29
74LS14	1.25	74LS174	.99
74LS15	.39	74LS175	.99
74LS20	.29	74LS181	2.25
74LS21	.29	74LS190	1.10
74LS22	.29	74LS191	1.10
74LS26	.25	74LS192	1.10
74LS27	.35	74LS193	1.10
74LS28	.39	74LS194	1.10
74LS30	.29	74LS195	1.10
74LS32	.39	74LS196	.89
74LS33	.39	74LS197	1.65
74LS37	.39	74LS221	1.25
74LS38	.32	74LS240	4.50
74LS40	.33	74LS241	2.40
74LS42	.89	74LS242	1.50
74LS47	.89	74LS243	2.50
74LS48	.79	74LS244	2.60
74LS51	.29	74LS247	1.10
74LS54	.29	74LS248	1.10
74LS55	.29	74LS251	1.99
74LS73	.44	74LS253	.99
74LS74	.59	74LS257	.99
74LS75	.49	74LS258	.99
74LS76	.45	74LS259	1.99
74LS83	.89	74LS260	.69
74LS85	1.25	74LS261	1.75
74LS86	.45	74LS266	.49
74LS90	.49	74LS273	1.50
74LS92	.75	74LS275	4.50
74LS93	.59	74LS279	.75
74LS95	.99	74LS283	.79
74LS96	1.15	74LS293	1.95
74LS107	.39	74LS295	.99
74LS109	.45	74LS298	.79
74LS112	.29	74LS365	.85
74LS113	.29	74LS366	.79
74LS114	.29	74LS367	.85
74LS122	.49	74LS368	.85
74LS123	.99	74LS373	3.05
74LS124	1.35	74LS374	1.95
74LS125	.89	74LS377	3.90
74LS126	.39	74LS378	1.25
74LS132	.79	74LS386	.65
74LS138	.88	74LS393	1.95
74LS139	.88	74LS395	1.45
74LS145	1.25	74LS399	2.95
74LS151	.67	74LS424	1.95
74LS153	.79	74LS668	1.25
74LS154	1.79	74LS670	2.49
74LS155	.89	81LS 96	1.45
74LS156	.69	81LS 97	1.55

LINEARS

Order by Cat No. 999 and type

TYPE NO.	PRICE	TYPE NO.	PRICE
101 H	1.79	340 K-24	1.75
103 H-3.9	1.39	340 T-5	.99
103 H-5.1	1.39	340 T-6	.99
103 H-5.6	1.39	340 T-8	.99
301 AH	.39	340 T-12	.99
301 AN-8	.32	340 T-15	.99
304 H	2.25	340 T-18	.99
305 H	1.30	340 T-24	.99
307 N	.49	358 N-8	.59
308 H	.79	379 M	5.75
308 N-8	.59	381 N	2.75
308 AH	.99	386 N	.79
309 H	1.10	387 AN	1.25
309 K	1.50	389 N	1.85
311 H	.88	394 H	3.50
311 N	.88	555 N-8	.35
311 N-8	.49	556 N	.79
312 H	1.95	565 N	.99
317 T	2.75	567 N	.99
317 H	2.75	703 N-8	.49
318 N-8	.79	709 N-8	.25
319 H	1.30	723 N	.49
320 H-5	.95	741 N	.39
320 H-6	.95	741 N-8	.39
320 H-12	.95	741 H	.79
320 H-15	.95	747 H	1.25
320 H-24	.95	747 N	1.25
320 K-5	1.90	1455	1.25
320 K-12	1.90	1458 N-8	.49
320 K-15	1.85	1488 N	1.49
320 K-24	1.85	1489 N	1.39
320 T-5	1.10	1889 N	2.95
320 T-12	1.10	2900 N	.99
320 T-15	1.10	3302	.39
320 T-24	1.10	3401	.55
321 H	6.50	3900	.55
322 H	1.75	3911	.99
323 K	5.95	4194	5.95
324 N	.89	4250	1.25
339 N	.99	5369 N-8	1.95
340 K-5	1.75	75451	.39
340 K-8	1.75	75452	.79
340 K-12	1.75	75453	.49
340 K-15	1.75	75491	.99
340 K-18	1.75		

Special Purpose IC's

Order by Cat No. 999 and type

Type	Description	PRICE
11C90	650 MHz prescaler	16.50
AY5-1013A	UART, 30K baud	4.50
AY5-1014A	UART, 40K baud	7.75
FD1771B01	Floppy disk controller	39.00
BR1941L	Dual baud rate gen	9.50
KR2376-ST	ASCII keyboard encoder	9.50
2513	Character gen, upper case	9.50
7107	DPM, led	10.75
ICM7207A/7208	Frequency counter	24.00
8038	Voltage controlled oscillator	3.95
DM8131	6-bit bus comparator	2.40
DM8833	single ended line trans	.90
DM8836	line receiver, single ended	.80
TA7205P	4.8 watt audio amp	2.75
SN76477	Sound generator	3.50
MM5375AC	6 digit clock, com anode	1.75
IH5004	2xSPST jfet switch w/driver	.90
MC14410	Touch tone encoder	8.50
MC14411	Baud rate generator, 1MHz	15.00
8271	Floppy disk controller	17.50

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The best 5¼" drive available today! Features track-to-track access time of 5 miliseconds, five times faster than competitive drives. Custom designed pulley-band design increases head position accuracy, and guarantees on-track repeatability for the life of the drive. Front door prevents foreign matter from entering the drive. Automatic disk positioning, auto-ejection. 1½% speed stability. No mechanical switches. Completely burned-in! All MPI heads are specified for dual density and far exceed industry standards.

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Cat No. 1485*	MPI 51 single sided drive		4lbs
Cat No. 1486*	MPI 52 dual sided drive		4lbs
Cat No. 1147	single sided Verbatim Disks	10 for 29.00	1lb
Cat No. 1492	dual sided Verbatim Disks	10 for 59.00	1lb
Cat No. 2244	Metal enclosure for drive	25.00	3lbs
Cat No. 1485D	MPI Manual only	1.50	2oz

RAMS/EPROMS

Order by Cat No. 999 and type

TYPE NO.	PRICE	TYPE NO.	PRICE
1101	.79	TMS 4045-300	7.25
2101-250	1.95	4116-300	11.65
2101-450	1.25	4116-250	12.75
21L02-650	.79	4116-200	13.75
21L02-450	1.10	4116-150	14.90
21L02-250	1.25	9050 CDC	4.50
2111-400	2.95	91L02-450	.79
2114-300	7.25	1702 A	4.25
2114-200	9.75	TMS 2532	86.00
4027P-2	3.90	2708	9.15
TMS 4045-450	6.50	2716	27.00

MICROPROCESSOR SUPPORTS

Order by Cat No. 999 and type

NO.	PRICE	NO.	PRICE
8212	2.95	Z80A CTC	13.95
8214	4.95	Z80A SIO	55.00
8216	2.60		
8224	3.95	6810	5.95
8226	3.95	6820/6520	6.96
8228	5.95	6821	6.95
8238	6.75	6828	11.95
8251	6.95	6850	9.95
8253	11.50	6852	6.50
8255	7.95	6860	9.95
8257	15.95		
8259	18.95	1822	18.95
8279	9.50	1852	7.50
8271	17.50	1854	13.95
Z80A-PIO	13.95	1861	15.95

CMOS

Order by Cat No. 999 and type

TYPE NO.	PRICE	TYPE NO.	PRICE
CD 4000	.19	CD 4028	.85
CD 4001	.23	CD 4030	.45
CD 4002	.23	CD 4035	.99
CD 4006	1.09	CD 4040	1.10
CD 4007	.25	CD 4044	.79
CD 4008	.28	CD 4045	.89
CD 4009	.45	CD 4046	1.19
CD 4010	.39	CD 4049	.45
CD 4011	.28	CD 4050	.45
CD 4012	.25	CD 4051	1.15
CD 4013	.36	CD 4052	.69
CD 4014	.99	CD 4053	1.19
CD 4015	.99	CD 4066	.85
CD 4016	.45	CD 4069	.49
CD 4017	1.10	CD 4071	.26
CD 4018	.99	CD 4081	.29
CD 4019	.42	CD 4082	.29
CD 4020	1.10	CD 4510	.99
CD 4021	1.25	CD 4516	.79
CD 4022	1.10	CD 4519	.59
CD 4023	.29	CD 4522	1.25
CD 4024	.75	CD 4526	1.25
CD 4025	.26	CD 4528	.99
CD 4026	1.45	CD 4529	.49
CD 4027	.49		

MICROPROCESSORS

Order by Cat No. 999 and type

TYPE NO.	PRICE
Z80 A	12.75
1802	16.50
6502	14.50
6800	6.50
8035	11.75
8080 A	6.60
8085	15.95
TMS 9900	49.00

THIS MONTH'S SPECIALS

Cat No.	Description	Price
KR2376-ST	ASCII ENCODER ROM, 128 char	$9.50
1142	C-10 DATA CASSETTES, for TRS-80, Apple, Exidy	4 for 5.00
1944	4" CABLE TIES, like Bar-Lok or Ty-Wrap	20 for 1.00
1205	TO-3 HEATSINKS, black anodized	4 for 2.00
1206	TO-220 HEATSINKS, black anodized	4 for 1.00
1386	COMPUTER MAINFRAME TRANSFORMER, 8V-16A± 16V-4A	39.00
1855	SOLID STATE MINI BEEPERS, 9VDC	2.00
1536	2½" PANEL METER, D'Arsonval, 200uA, zero adjust	3.00
1853	2-3/3" PANEL METER, D'Arsonval, 175uA, zero adjust	2.00
1952	NI-CAD POWER PAK, 2.4VDC, sub-c cells	3.50
1931	ALPHA-NUMERIC READOUT, TIL305, MAN-2A equal, 5x7 led	5.50
1473	DB25 FEMALE CONNECTOR, soldertail	4.35
1474	DB25 MALE CONNECTOR, soldertail	2.95
1477	DB25 CONNECTOR HOODS	1.36
2041	IC EXTRACTOR, for 8-24 pin dips	1.75
1471	20V, 6A POWER TRANSFORMER, 110/220 pri.	5.50
1398	24VCT, 800mA POWER XFMR, 110 pri.	3.75
1470	12.5V, 750mA POWER XFMR, 110 pri.	4.00
1546	5.8V @ 850mA, 5V @ 190mA, PLUG-IN XFMR	4.00
1339	9V 3A POWER TRANSFORMER, 110 pri.	4.00
1007	12V, 300mA TRANSFORMER, 110 pri.	.75
1487	40-PIN IC SOCKETS, lo-profile	3 for 1.00
1797	TO-3 HEATSINK, 100 watts, Wakefield #423	2.50
1862	INLINE FUSE HOLDER, 3AG	3 for 1.00
1539	2.4V NI-CAD BATTERIES, 750mAH, rechargeable	3.00
1847	CHERRY KEYBOARD SWITCHES, SPST-n.o.	10 for 2.00
1909	1.4V MERCURY BATTERY, lg penlite	2 for 1.50
1525	TO-5 HEATSINKS, slides on TO-5's	5 for 1.00
1117-14	14 PIN IC SOCKETS, TI, lo-profile	10 for 1.40
117-16	16 PIN IC SOCKETS, TI, lo-profile	10 for 1.60
1226	LINE CORDS, 6ft, 18ga, with molded plug	3 for 1.00
1233	1N4148/914 SWITCHING DIODES	25 for 1.00
1399	6 PIN CONNECTOR SET, male & mate, screw lok	1.50
1524	1uH CHOKE, axial leads	3 for 1.00
1749	4PDT RELAY, blok, 24V, 700 , 2A cont.	2.00
1521	24V PIGTAIL LAMPS, Sylvania 28ES	4 for 1.00
1150-3.57	TIME BASE CRYSTAL, 3.579545 MHz, .02%	2.00
1493	.3" LCD CLOCK MODULE, 4 digit, FK10CM, 1.5VDC	25.00
1743	.5" LED CLOCK MODULE + XFMR, MA1002	9.00
1119-6800	COMPUTER GRADE CAP, 6800uF, 25V	2 for 1.00
1537	TILT SWITCH, mercury, metal encased	2 for 1.00
1119-120K	COMPUTER GRADE CAP, 120,000uF, 15V	3.50
1001-50	1N4001 RECTIFIERS, 1A, 50PIV	20 for 1.00
1001-100	1N4002 RECTIFIERS, 1A, 100PIV	16 for 1.00
1001-200	1N4003 RECTIFIERS, 1A, 200PIV	12 for 1.00
1289	4 POS DIP SWITCH	1.25
1290	7 POS DIP SWITCH	1.40
1291	8 POS DIP SWITCH	1.60
1099	MINI PUSH SWITCHES, SPST, red button	3 for 1.00
1270	HEAT SINK CLIPS, protects when soldering	2 for 1.00
1378	AC UTILITY OUTLET, 2 prong, solder lugs	4 for 1.00
1914	2 DIGIT READOUT, MAN6610, .5", com anode	1.50
1915	1½ DIGIT READOUT, MAN 6630, .5", com anode	1.25
1454	MJE3055 POWER TRANSISTOR, power tab 2N3055	2.00
1453	2N2222 SWITCHING TRANSISTORS, NPN	4 for 1.00

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$29/box of 10
2 for $55

Cat No.	Type	Description
1147	525-01	Soft, TRS-80
1148	525-10	10 hole hard, Apple, Northstar, H8
1149	525-16	16 hole hard, Micropolis

16K MEMORY ADD-ON

$75 2 for $140

For TRS-80, Apple, Exidy

Installs in minutes, no special tools required. Complete with detailed instructions. Wt 4 oz.

Cat No.	Description
1156	For TRS-80 keyboard unit
1156A	TRS-80 without buffered cable
1156B	TRS-80 with buffered cable
1156C	For Apple
1156D	For Exidy Sorcerer

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7400 TTL

		SN7470N	.29		
		SN7472N	.29		
SN7400N	.16	SN7473N	.35	SN74160N	.89
SN7401N	.18	SN7474N	.35	SN74161N	.89
SN7402N	.18	SN7475N	.49	SN74162N	1.95
SN7403N	.18	SN7476N	.35	SN74163N	.89
SN7404N	.18	SN7479N	5.00	SN74164N	.89
SN7405N	.20	SN7480N	.50	SN74165N	.89
SN7406N	.29	SN7482N	.99	SN74166N	1.25
SN7407N	.29	SN7483N	.59	SN74167N	1.95
SN7408N	.20	SN7485N	.79	SN74170N	1.59
SN7409N	.20	SN7486N	.35	SN74172N	6.00
SN7410N	.18	SN7489N	1.75	SN74173N	1.25
SN7411N	.25	SN7490N	.45	SN74174N	.89
SN7412N	.25	SN7491N	.59	SN74175N	.79
SN7413N	.40	SN7492N	.43	SN74176N	.79
SN7414N	.70	SN7493N	.43	SN74177N	.79
SN7416N	.25	SN7494N	.65	SN74179N	1.95
SN7417N	.25	SN7495N	.65	SN74180N	.79
SN7420N	.20	SN7496N	.65	SN74181N	1.95
SN7421N	.29	SN7497N	3.00	SN74182N	.79
SN7422N	.39	SN74100N	.89	SN74184N	1.95
SN7423N	.25	SN74107N	.35	SN74185N	1.95
SN7425N	.29	SN74109N	.59	SN74186N	9.95
SN7426N	.29	SN74116N	1.95	SN74188N	3.95
SN7427N	.25	SN74121N	.35	SN74190N	1.29
SN7429N	.39	SN74122N	.39	SN74191N	1.25
SN7430N	.20	SN74123N	.49	SN74192N	.79
SN7432N	.25	SN74125N	.49	SN74193N	.79
SN7437N	.25	SN74126N	.49	SN74194N	.89
SN7438N	.25	SN74132N	.75	SN74195N	.69
SN7439N	.25	SN74136N	.75	SN74196N	.89
SN7440N	.20	SN74141N	.79	SN74197N	.89
SN7441N	.89	SN74142N	2.95	SN74198N	1.49
SN7442N	.49	SN74143N	2.95	SN74199N	1.49
SN7443N	.75	SN74144N	2.95	SN74S20D	4.95
SN7444N	.75	SN74145N	.79	SN74251N	.99
SN7445N	.75	SN74147N	1.95	SN74279N	.79
SN7446N	.69	SN74148N	1.29	SN74283N	2.25
SN7447N	.59	SN74150N	.89	SN74284N	3.95
SN7448N	.79	SN74151N	.59	SN74285N	3.95
SN7450N	.20	SN74152N	.59	SN74365N	.69
SN7451N	.20	SN74153N	.59	SN74366N	.69
SN7453N	.20	SN74154N	.99	SN74367N	.69
SN7454N	.20	SN74155N	.79	SN74368N	.69
SN7459A	.25	SN74156N	.79	SN74390N	1.95
SN7460N	.20	SN74157N	.65	SN74393N	1.95

C/MOS

CD4000	.23	CD4028	.89	CD4070	.55
CD4001	.23	CD4029	1.19	CD4071	.23
CD4002	.23	CD4030	.49	CD4072	.49
CD4006	1.19	CD4035	.99	CD4076	1.39
CD4007	.25	CD4040	1.19	CD4081	.23
CD4009	.49	CD4041	1.25	CD4082	.23
CD4010	.49	CD4042	.99	CD4093	.99
CD4011	.23	CD4043	.89	CD4098	2.49
CD4012	.25	CD4044	.89	MC14409	14.95
CD4013	.39	CD4046	1.79	MC14410	14.95
CD4014	1.39	CD4047	2.50	MC14411	14.95
CD4015	1.19	CD4048	1.35	MC14419	4.95
CD4016	.49	CD4049	.49	MC14433	19.95
CD4017	1.19	CD4050	.49	MC14506	.75
CD4018	.99	CD4051	1.19	MC14507	.99
CD4019	.49	CD4052	1.19	MC14562	14.50
CD4020	1.19	CD4053	1.19	MC14583	3.50
CD4021	1.39	CD4056	2.95	CD4508	3.95
CD4022	1.19	CD4059	9.95	CD4510	1.39
CD4023	.23	CD4060	1.45	CD4511	1.29
CD4024	.79	CD4066	.79	CD4515	2.95
CD4025	.23	CD4068	.39	CD4518	1.29
CD4026	2.25	CD4069	.45	CD4520	1.29
CD4027	.69			CD4566	2.25

74C00

74C00	.39	74C85	2.49	74C163	2.49
74C02	.39	74C90	1.95	74C164	2.49
74C04	.39	74C93	1.95	74C173	2.60
74C08	.49	74C95	1.95	74C192	2.49
74C10	.39	74C107	1.25	74C193	2.49
74C14	1.95	74C154	3.00	74C195	2.49
74C20	.39	74C157	2.15	74C922	7.95
74C30	.39	74C160	2.49	74C923	6.25
74C42	1.95	74C161	2.49	74C925	8.95
74C48	2.49			74C926	8.95
74C73	.89			80C95	1.50
74C74	.89			80C97	1.50

LINEAR

78MG	1.75			LM710N	.79
LM106H	.99			LM711N	.39
LM300H	.80			LM723N/H	.55
LM301CN/H	.35	LM340K-18	1.35	LM733N	1.00
LM302H	.75	LM340K-24	1.35	LM739N	1.19
LM304H	1.00	LM340T-5	1.25	LM741CN/H	.35
LM305H	.60	LM340T-6	1.25	LM741-14N	.39
LM307CN/H	.35	LM340T-8	1.25	LM747N/H	.79
LM308CN/H	1.00	LM340T-12	1.25	LM748N/H	.39
LM309H	1.10	LM340T-15	1.25	LM1310N	1.95
LM309K	1.25	LM340T-24	1.25	LM1458CN/H	.59
LM310CN	1.15	LM358N	1.00	MC1488N	1.95
LM311N/H	.90	LM370N	1.95	MC1489N	1.95
LM312H	1.95	LM373N	3.25	LM1496N	.95
LM317K	6.50	LM377N	4.00	LM1556V	1.75
LM318CN/H	1.50	LM380N	1.25	MC1741SCP	3.00
LM319N	1.30	LM380CN	.99	LM2111N	1.95
LM320K-5	1.35	LM381N	1.79	LM2901N	2.95
LM320K-5.2	1.35	LM382N	1.79	LM3053N	1.50
LM320K-12	1.35	NE501N	8.00	LM3065N	1.49
LM320K-15	1.35	NE510A	6.00	LM3900N(3401)	.59
LM320K-18	1.35	NE529A	4.95	LM3905N	1.49
LM320K-24	1.35	NE531H/V	3.95	LM3909N	1.25
LM320T-5	1.25	NE536T	6.00	MC5558V	.59
LM320T-5.2	1.25	NE540L	6.00	8038B	4.95
LM320T-8	1.25	NE544N	4.95	LM7545ON	.49
LM320T-12	1.25	NE555V	1.30	75451CN	.39
LM320T-15	1.25	NE555V	.39	75452CN	.39
LM320T-18	1.25	NE556N	.99	75453CN	.39
LM320T-24	1.25	NE560B	5.00	75454CN	.39
LM323K-5	5.95	NE562B	5.00	75491CN	.79
LM324N	1.49	NE565N/H	1.25	75492CN	.89
LM339N	.99	NE566CN	1.75	75493N	.89
LM340K-5	1.35	NE567V/H	.99	75494CN	.89
LM340K-6	1.35	NE570N	4.95	RC4136	1.25
LM340K-8	1.35	LM703CN/H	.69	RC4151	3.95
LM340K-12	1.35	LM709N/H	.29	RC4194	4.95
LM340K-15	1.35			RC4195	4.49

74LS00TTL

74LS00	.29	74LS47	.89	74LS138	.89
74LS01	.29	74LS51	.29	74LS139	.89
74LS02	.29	74LS54	.29	74LS151	.89
74LS03	.29	74LS55	.29	74LS155	.89
74LS04	.35	74LS73	.45	74LS157	.89
74LS05	.35	74LS74	.45	74LS160	1.15
74LS08	.29	74LS75	.59	74LS161	1.15
74LS09	.35	74LS76	.45	74LS162	1.25
74LS10	.29	74LS78	.49	74LS163	1.15
74LS11	.75	74LS83	.89	74LS164	1.25
74LS13	.59	74LS85	1.25	74LS175	.99
74LS14	1.25	74LS86	.45	74LS181	2.49
74LS15	.35	74LS90	.59	74LS190	1.15
74LS20	.29	74LS92	.75	74LS191	1.15
74LS21	.35	74LS93	.75	74LS192	1.15
74LS22	.35	74LS95	.99	74LS193	1.15
74LS26	.35	74LS96	1.15	74LS194	1.15
74LS27	.35	74LS107	.45	74LS195	1.15
74LS28	.35	74LS109	.45	74LS253	.99
74LS30	.29	74LS112	.45	74LS257	.89
74LS32	.35	74LS123	1.25	74LS258	1.75
74LS37	.45	74LS125	.89	74LS260	.69
74LS40	.35	74LS132	.99	74LS279	.75
74LS42	.89	74LS136	.49	74LS367	.75
				74LS368	.75
				74LS670	2.49

Cromemco
incorporated



8K Bytesaver II

Cromemco's 8K BYTESAVER® card provides a built-in programmer for the popular 2708 PROM and has the capacity for a full 8K bytes of PROM memory storage. The BYTESAVER® II also offers a number of new features including convenient switch selection of board address and Cromemco's powerful memory bank selection. The BYTESAVER® II is assembled and tested (Model 8KBS-W) for $245.

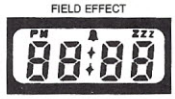
Memory Capacity: 8K bytes
Memory Type: 2708 PROM or equivalent
Memory Access Time: 450 nanoseconds
Wait States at 2MHz: none required
Wait States at 4MHz: one per machine cycle
Bus: S-100
Power Requirements: +8V @ 0.8A, +18V @ 0.4A, −18V @ 0.2A
Operating Environment: 0-55°C.

Assembled
8KBS-W....$245.00

DISCRETE LEDS

	.200" dia.				.125" dia.		
XC556R	red	5/$1		XC209R	red	5/$1	
XC556G	green	4/$1		XC209G	green	4/$1	
XC556Y	yellow	4/$1		XC209Y	yellow	4/$1	
XC556C	clear	4/$1					
	.200" dia.				.185" dia.		
XC22R	red	5/$1		XC526R	red	5/$1	
XC22G	green	4/$1		XC526G	green	4/$1	
XC22Y	yellow	4/$1		XC526Y	yellow	4/$1	
	.170" dia.			XC526C	clear	4/$1	
MV10B	red	4/$1					
	.085" dia.				.190" dia.		
MV50	red	6/$1		XC111R	red	5/$1	
	INFRA-RED LED			XC111G	green	4/$1	
	1/4"x1/4"x1/16" flat			XC111Y	yellow	4/$1	
	5/$1			XC111C	clear	4/$1	

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CLASS II
FIELD EFFECT



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INCLUDES CONNECTOR

T1001-Transmissive $7.95
T1001A-Reflective 8.25

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE	TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode-red	.270	2.95	MAN 6730	Common Anode-red ± 1	.560	.99
MAN 2	5 x 7 Dot Matrix-red	.300	4.95	MAN 6740	Common Cathode-red-D.D.	.560	.99
MAN 3	Common Cathode-red	.125	.25	MAN 6750	Common Cathode-red ± 1	.560	.99
MAN 4	Common Cathode-red	.187	1.95	MAN 6760	Common Anode-red	.560	.99
MAN 7G	Common Anode-green	.300	1.25	MAN 6780	Common Cathode-red	.560	.99
MAN 7Y	Common Anode-yellow	.300	.99	DL701	Common Anode-red ± 1	.300	.99
MAN 72	Common Anode-red	.300	.75	DL704	Common Cathode-red	.300	.99
MAN 74	Common Cathode-red	.300	1.25	DL707	Common Anode-red	.300	.99
MAN 82	Common Anode-yellow	.300	.49	DL728	Common Cathode-red	.500	1.49
MAN 84	Common Cathode-yellow	.300	.99	DL741	Common Anode-red	.600	1.25
MAN 3620	Common Anode-orange	.300	.49	DL746	Common Anode-red ± 1	.630	1.49
MAN 3630	Common Anode-orange ± 1	.300	.99	DL747	Common Anode-red	.600	1.49
MAN 3640	Common Cathode-orange	.300	.99	DL749	Common Cathode-red ± 1	.630	1.49
MAN 4610	Common Anode-orange	.300	.99	DL750	Common Cathode-red	.600	1.49
MAN 4640	Common Cathode-orange	.400	.99	DL338	Common Cathode-red	.110	.35
MAN 4710	Common Anode-red	.400	.99	FND70	Common Cathode	.250	.69
MAN 4730	Common Anode-red ± 1	.400	.99	FND358	Common Cathode ± 1	.357	.99
MAN 4740	Common Cathode-red	.400	.99	FND359	Common Cathode	.357	.75
MAN 4810	Common Anode-yellow	.400	.99	FND503	Common Cathode(FND500)	.500	.99
MAN 4840	Common Cathode-yellow	.400	.99	FND507	Common Anode (FND510)	.500	.99
MAN 6610	Common Anode-orange-D.D.	.560	.99	5082-7730	Common Anode-red	.300	.99
MAN 6630	Common Anode-orange ± 1	.560	.99	HDSP-3400	Common Anode-red	.800	1.50
MAN 6640	Common Cathode-orange-D.D.	.560	.99	HDSP-3403	Common Cathode red	.800	1.50
MAN 6650	Common Cathode-orange ± 1	.560	.99	5082-7300	4 x 7 sgl. Digit-RHDP	.600	19.95
MAN 6660	Common Anode-orange	.560	.99	5082-7302	4 x 7 Sgl. Digit-LHDP	.600	19.95
MAN 6680	Common Cathode-orange	.560	.99	5082-7304	Overrange character (±1)	.600	15.00
MAN 6710	Common Anode-red-D.D.	.560	.99	5082-7340	4 x 7 Sgl. Digit-Hexadecimal	.600	22.50

RCA LINEAR

CA3013T	2.15	CA3082N	2.00
CA2023T	2.56	CA3083N	1.60
CA3035T	2.48	CA3086N	.85
CA3039T	1.35	CA3089N	3.75
CA3046N	1.30	CA3130T	1.39
CA3059N	3.25	CA3140T	1.25
CA3060N	3.25	CA3160T	1.25
CA3080T	.85	CA3401N	.59
CA3081N	2.00	CA3600N	3.50

CALCULATOR CHIPS/DRIVERS

MM5725	$2.95
MM5738	2.95
DM8864	2.00
DM8865	1.00
DM8687	.75
DM8889	.75
9374 7 seg.	
C.A. LED driver	1.50

CLOCK CHIPS

MM5309	$4.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5387/1998A	4.95
CT 7001	6.95

MOTOROLA

MC1408L7	$4.95
MC1408L8	5.75
MC1439L	2.95
MC3022P	2.95
MC3061P	3.50
MC4016(74416)	7.50
MC4024P	3.95
MC4040P	6.95
MC4044P	4.50

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin LP	$.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
14 pin ST	$.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
8 pin SG	$.30	.27	.24
14 pin SG	.35	.32	.29
16 pin SG	.38	.35	.32
18 pin SG	.52	.47	.43
8 pin WW	$.39	.38	.31
10 pin WW	.45	.41	.37
14 pin WW	.39	.38	.37
16 pin WW	.43	.42	.41
18 pin WW	.75	.68	.62
20 pin WW	.85	.79	.72



SOLDERTAIL STANDARD (TIN)

SOLDERTAIL STANDARD (GOLD)

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	1-24	25-49	50-100
22 pin LP	$ .37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61
28 pin ST	$ .99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30
24 pin SG	$ .70	.63	.57
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45
22 pin WW	$ .95	.85	.75
24 pin WW	1.05	.95	.85
28 pin WW	1.40	1.25	1.10
36 pin WW	1.59	1.45	1.30
40 pin WW	1.75	1.55	1.40

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		10 OHM	12 OHM	15 OHM	18 OHM	22 OHM		
ASST. 1	5 ea.	27 OHM	33 OHM	39 OHM	47 OHM	56 OHM	50 PCS	$1.75
		68 OHM	82 OHM	100 OHM	120 OHM	150 OHM		
ASST. 2	5 ea.	180 OHM	220 OHM	270 OHM	330 OHM	390 OHM	50 PCS	1.75
		470 OHM	560 OHM	680 OHM	820 OHM	1K		
ASST. 3	5 ea.	1.2K	1.5K	1.8K	2.2K	2.7K	50 PCS	1.75
		3.3K	3.9K	4.7K	5.6K	6.8K		
ASST. 4	5 ea.	8.2K	10K	12K	15K	18K	50 PCS	1.75
		22K	27K	33K	39K	47K		
ASST. 5	5 ea.	56K	68K	82K	100K	120K	50 PCS	1.75
		150K	180K	220K	270K	330K		
ASST. 6	5 ea.	390K	470K	560K	680K	820K	50 PCS	1.75
		1M	1.2M	1.5M	1.8M	2.2M		
ASST. 7	5 ea.	2.7M	3.3M	3.9M	4.7M	5.6M	50 PCS	1.75
ASST. 8R	Includes Resistor Assortments 1-7 (350 PCS.)							$9.95 ea.

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XR215	4.40			XR2556	3.20
XR320	1.55			XR2567	2.99
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XR555	.39	XR1800	3.20	XR4136	1.25
XR556	.99	XR2206	4.40	XR4151	3.95
XR567CP	.99	XR2207	3.85	XR4194	4.95
XR567CT	1.25	XR2208	5.20	XR4202	3.60
XR1310P	1.95	XR2209	1.75	XR4212	2.05
XR1468CN	3.85	XR2211	5.25	XR4558	.75
XR1488	1.95	XR2212	4.35	XR4739	1.15
XR1489	1.95	XR2240	3.45	XR4741	1.47

DIODES

TYPE	VOLTS	W	PRICE
1N746	3.3	400m	4/1.00
1N751	5.1	400m	4/1.00
1N752	5.6	400m	4/1.00
1N753	6.2	400m	4/1.00
1N754	6.8	400m	4/1.00
1N757	9.0	400m	4/1.00
1N759	12.0	400m	4/1.00
1N959	8.2	400m	4/1.00
1N965	15	400m	4/1.00
1N5232	5.6	500m	28
1N5234	6.2	500m	28
1N5235	6.8	500m	28
1N5236	7.5	500m	28
1N5242	12	500m	28
1N5245	15	500m	28
1N456	25	40m	6/1.00
1N458	150	7m	6/1.00
1N485A	180	10m	5/1.00
1N4001	50	PIV 1 AMP	12/1.00

TYPE	VOLTS	W	PRICE
1N4002	100	PIV 1 AMP	12/1.00
1N4003	200	PIV 1 AMP	12/1.00
1N4004	400	PIV 1 AMP	12/1.00
1N4005	600	PIV 1 AMP	10/1.00
1N4006	800	PIV 1 AMP	10/1.00
1N4007	1000	PIV 1 AMP	10/1.00
1N3600	50	200m	6/1.00
1N4148	75	10m	15/1.00
1N4154	35	10m	12/1.00
1N4733	5.1	1w	28
1N4734	5.6	1w	28
1N4735	6.2	1w	28
1N4736	6.8	1w	28
1N4738	8.2	1w	28
1N4742	12	1w	28
1N4744	15	1w	28
1N1183	50	PIV 35 AMP	1.60
1N1184	100	PIV 35 AMP	1.70
1N1185	150	PIV 35 AMP	1.70
1N1186	200	PIV 35 AMP	1.80
1N1188	400	PIV 35 AMP	3.00

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C36D	15A @ 400V	SCR(2N1849)	$1.95
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MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

C106B1	.50			2N3904	4/1.00
MPSA05	.30	2N3055	.89	2N3905	4/1.00
MPSA06	5/1.00	MJE3055	1.00	2N3906	4/1.00
TIS97	6/1.00	2N3392	5/1.00	2N4013	3/1.00
TIS98	6/1.00	2N3398	5/1.00	2N4123	5/1.00
40409	1.75	PN3567	3/1.00	PN4249	4/1.00
40410	1.75	PN3568	4/1.00	PN4250	4/1.00
40673	1.75	PN3569	4/1.00	2N4400	4/1.00
2N918	4/1.00	MPS3638A	5/1.00	2N4401	4/1.00
2N2219A	2/1.00	MPS3702	5/1.00	2N4402	4/1.00
2N2221A	4/1.00	2N3704	5/1.00	2N4403	4/1.00
2N2222A	5/1.00	MPS3704	5/1.00	2N4409	5/1.00
PN2222 Plastic	7/1.00	2N3705	5/1.00	2N5086	4/1.00
2N2369A	4/1.00	MPS3705	5/1.00	2N5087	4/1.00
MPS2369	5/1.00	2N3706	5/1.00	2N5088	4/1.00
2N2484	4/1.00	MPS3706	5/1.00	2N5089	4/1.00
2N2906	4/1.00	2N3707	5/1.00	PN5129	5/1.00
2N2907	5/1.00	2N3711	5/1.00	PN5134	5/1.00
PN2907 Plastic	7/1.00	2N3724A	.65	PN5138	5/1.00
2N2925	5/1.00	2N3725A	1.00	2N5139	5/1.00
MJE2955	1.25	2N3772	2.25	2N5210	5/1.00
2N3053	2/1.00	2N3823	1.00	2N5449	3/1.00
		2N3903	5/1.00	2N5951	3/1.00

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.0022	.12	.10	.07
.0047mf	.12	.10	.07
.01mf	.12	.10	.07

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.0047μF	.05	.04	.035
.01μF	.05	.04	.035
.022μF	.06	.05	.04
.047μF	.06	.05	.04
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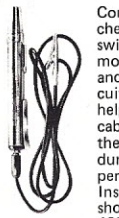
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15/25V	.75	.68	.59
22/6V	.75	.60	.50
.15/35V	.28	.23	.17
.22/35V	.28	.23	.17
.33/35V	.28	.23	.17
.47/35V	.28	.23	.17
.68/35V	.28	.23	.17
1.0/35V	.28	.23	.17

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead				Radial Lead			
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.14	.12	.09	1.0/16V	.15	.13	.10
4.7/25V	.15	.13	.10	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V

Continuity Tester and Flashlight

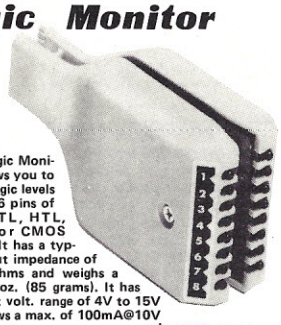


Convenient versatile tool for quickly checking continuity of dead circuits, switches, appliances, cords, fuses, motors, control equipment, coils and panel boards. Also tests circuits for low-resistance shorts and helps identify wires in multi-wire cables. Dozens of other uses. Plus the added convenience of a handy, durable flashlight. Uses two AA size penlight batteries (not furnished). Insulated clip prevents accidental shorting to case. Alligator clip has 48" lead with plug.

RT300 ..... **$7.95**

CONTINENTAL SPECIALTIES

Logic Monitor



The Logic Monitor allows you to check logic levels on all 16 pins of any DTL, HTL, TTL, or CMOS device. It has a typical input impedance of 100K ohms and weighs a mere 3 oz. (85 grams). It has an input volt. range of 4V to 15V and draws a max. of 100mA@10V

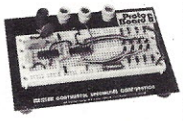
LM-1 ..... **$70.00**

Proto Clips



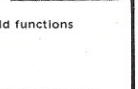
14-PIN CLIP	PC-14	$ 4.50
16-PIN CLIP	PC-16	$ 4.75
24-PIN CLIP	PC-24	$10.00
40-PIN CLIP	PC-40	$16.00

Proto Boards



PB-6	$17.95
PB-100	19.95
PB-101	22.95
PB-102	26.95
PB-103	44.95
PB-104	55.95
PB-203	99.95
PB-203A	155.00
PB-203A-Kit	131.00

Jumbo 6-Digit Clock Kit



- ★ Four .630"ht. and two .300"ht. common anode displays
- ★ Uses MM5314 clock chip
- ★ Switches for hours, minutes and hold functions
- ★ Hours easily viewable to 30 feet
- ★ Simulated walnut case
- ★ 115 VAC operation
- ★ 12 or 24 hour operation
- ★ Includes all components, case and wall transformer
- ★ Size: 6¾ x 3⅛ x 1¾

JE747 ..... **$29.95**



- •Bright .300 ht. comm. cathode display
- •Uses MM5314 clock chip
- •Switches for hours, minutes and hold modes
- •Hrs. easily viewable to 20 ft.
- •Simulated walnut case
- •115 VAC operation
- •12 or 24 hr. operation
- •Incl. all components, case & wall transformer
- •Size: 6¾" x 3-1/8" x 1¾"

JE701

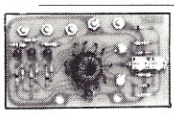
6-Digit Clock Kit $19.95

Regulated Power Supply



Uses LM309K. Heat sink provided. PC board construction. Provides a solid 1 amp @ 5 volts. Can supply up to ±5V, ±9V and ±12V with JE205 Adapter. Includes components, hardware and instructions. Size: 3½" x 5" x 2"H

JE200 ..... **$14.95**



ADAPTER BOARD —Adapts to JE200— ±5V, ±9V and ±12V

DC/DC converter with +5V input. Toriodal hi-speed switching XMFR. Short circuit protection. PC board construction. Piggy-back to JE 200 board. Size: 3½" x 2" x 9/16"H

JE205 ..... **$12.95**

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

8080A	CPU	$ 7.95
8212	8-Bit Input/Output	3.25
8214	Priority Interrupt Control	5.95
8216	Bi-Directional Bus Driver	3.49
8224	Clock Generator/Driver	3.95
8226	Bus Driver	3.49
8228	System Controller/Bus Driver	4.95
8238	System Controller	5.95
8251	Prog. Comm. I/O (USART)	7.95
8253	Prog. Interval Timer	14.95
8255	Prog. Periph. I/O (PPI)	9.95
8257	Prog. DMA Control	19.95
8259	Prog. Interrupt Control	19.95

6800/6800 SUPPORT DEVICES

MC6800	MPU	$14.95
MC6802CP	MPU with Clock and Ram	24.95
MC6810API	128X8 Static Ram	5.95
MC6821	Periph. Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	12.95
MC6830L8	1024X8 Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	7.95
MC6852	Synchronous Serial Data Adapt.	9.95
MC6860	0-600 bps Digital MODEM	12.95
MC6862	2400 bps Modulator	14.95
MC6880A	Quad 3-State Bus. Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS—MISCELLANEOUS

Z80(780C)	CPU	$14.95
Z80A(780-1)	CPU	16.95
CDP1802	CPU	19.95
2650	MPU	19.95
6502	CPU	11.95
8035	8-Bit MPU w/clock, RAM, 1/0 lines	19.95
P8085	CPU	19.95
TMS9900JL	16-Bit MPU w/hardware, multiply & divide	49.95

SHIFT REGISTERS

MM500H	Dual 25 Bit Dynamic	$.50
MM503H	Dual 50 Bit Dynamic	.50
MM504H	Dual 16 Bit Static	.50
MM506H	Dual 100 Bit Static	.50
MM510H	Dual 64 Bit Accumulator	.50
MM5016H	500/512 Bit Dynamic	.89
2504T	1024 Dynamic	3.95
2518	Hex 32 Bit Static	4.95
2522	Dual 132 Bit Static	2.95
2524	512 Static	.99
2525	1024 Dynamic	2.95
2527	Dual 256 Bit Static	2.95
2528	Dual 250 Static	4.00
2529	Dual 240 Bit Static	4.00
2532	Quad 80 Bit Static	2.95
3341	Fifo	6.95
74LS670	4X4 Register File (TriState)	2.49

UART'S

A-Y-5-1013	30K BAUD	5.95

MICROPROCESSOR MANUALS

M-Z80	User Manual	$7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

ROM'S

2513(2140)	Character Generator(upper case)	$9.95
2513(3021)	Character Generator(lower case)	9.95
2516	Character Generator	10.95
MM5230N	2048-Bit Read Only Memory	1.95

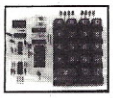
RAM'S

1101	256X1	Static	$1.49
1103	1024X1	Dynamic	.99
2101(8101)	256X4	Static	3.95
2102	1024X1	Static	1.75
21L02	1024X1	Static	1.95
2111(8111)	256X4	Static	3.95
2112	256X4	Static MOS	4.95
2114	1024X4	Static 450ns	7.95
2114L	1024X4	Static 450ns low power	10.95
2114-3	1024X4	Static 300ns	10.95
2114L-3	1024X4	Static 300ns low power	11.95
5101	256X4	Static	7.95
5280/2107	4096X1	Dynamic	4.95
7489	16X4	Static	1.75
74S200	256X1	Static Tristate	4.95
93421	256X1	Static	2.95
UPD414 (MK4027)	4K	Dynamic 16 pin	4.95
UPD416 (MK4116)	16K	Dynamic 16 pin 250ns	9.95
TMS4044-45NL	4K	Static	14.95
TMS4045	1024X4	Static	14.95
2117	16,384X1 (house marked)	Dynamic 350ns	9.95
MM5262	2KX1	Dynamic	4/1.00

PROM'S

1702A	2048	FAMOS	$5.95
2716INTEL	16K*	EPROM	59.95
TMS2516	16K*	EPROM	49.95
(2716)	*Requires single +5V power supply		
TMS2532	4KX8	EPROM	89.95
2708	8K	EPROM	10.95
2716 T.I	16K**	EPROM	29.95
	**Requires 3 voltages, —5V, +5V, +12V		
5203	2048	FAMOS	14.95
6301-1(7611)	1024	Tristate Bipolar	3.49
6330-1(7602)	256	Open C Bipolar	2.95
82S23	32X8	Open Collector	3.95
82S115	4096	Bipolar	19.95
825123	32X8	Tristate	3.95
74186	512	TTL Open Collector	9.95
74188	256	TTL Open Collector	3.95
74S287	1024	Static	2.95

JE600 HEXADECIMAL ENCODER KIT



FEATURES:
- Full 8 bit latched output for microprocessor use
- 3 User Define keys with one being bi-stable operation
- Debounce circuit provided for all 19 keys
- LED readout to verify entries
- Easy interfacing with standard 16 pin IC connector
- Only +5VDC required for operations

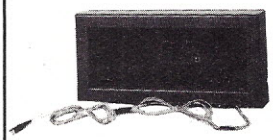
FULL 8 BIT LATCHED OUTPUT—19 KEYBOARD

The JE600 Encoder Keyboard provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8 bit microprocessor or 8 bit memory circuits. Three (3) additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with LED readouts. Also included is a key entry strobe.

JE600 ..... **$59.95**

Hexadecimal Keypad only **$14.95**

DIGITAL THERMOMETER KIT



- •Dual sensors—switching control for indoor/outdoor or dual monitoring
- •Continuous LED .8" ht. display
- •Range: -40°F to 199°F / -40°C to 100°C
- •Accuracy: ±1° nominal
- •Set for Fahrenheit or Celsius reading
- •Sim. walnut case - AC wall adapter incl.
- •Size: 3-1/4"H x 6-5/8"W x 1-3/8"D

JE300 ..... **$39.95**

62-Key ASCII Encoded Keyboard Kit



The JE610 62-Key ASCII Encoded Keyboard Kit can be interfaced into most any computer system. The JE610 Kit comes complete with an industrial grade keyboard switch assembly (62 keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and —12V @ 10mA for operation.

FEATURES:
- 60 Keys generate the full 128 characters, upper and lower case ASCII set
- Fully buffered
- 2 user-define keys provided for custom applications
- Caps lock for upper case only alpha characters
- Utilizes a 2376 (40 pin) encoder read only memory chip
- Outputs directly compatible with TTL/DTL or MOS logic arrays
- Easy interfacing with a 16-pin dip or 18-pin edge connector

JE610 ..... **$79.95**

62-Key Keyboard only . . $34.95

HICKOK

LX303 Portable LCD Digital Multimeter

- Big ½ inch high, 3½ Digit Liquid Crystal Display
- Over 200 Hours of operation with a 9V battery
- Automatic zero, polarity and overrange indication
- 100mV DC F.S. sensitivity
- 1% basic accuracy
- 19 ranges and functions
- Rugged Cycolac© case and removable cover, stores test lead set.
- Full one year warranty.



SPECIFICATIONS: DC volts (5 ranges): 0.1mV to 1000V; Accuracy ±0.5% rdg ±0.5% f.s.; Input imped: 10MΩ; Max. input 1kV except 800V on 200mV range. AC Volts (40Hz to 5kHz): 0.1V to 600V; Accuracy: ±1.0% rdg ±0.5% f.s. (−2dB max. at 5kHz); Max. input: 600V. Resistance (6 Low Power Ranges): 0.1 to 20MΩ; Accuracy: ±0.5% rdg ±0.5% f.s. (±1.5% rdg on 20MΩ range); input protected to 120VAC all ranges. DC Current (6 ranges): 01nA to 100mA; Accuracy: ±1.0% rdg ±0.5% f.s. Dimensions and Weight: 5-7/8" x 3-3/8" x 1-3/4", 8 oz.; POWER: 9V battery (not included) or Hickok AC adapter; READ RATE: 3/sec.

LX303 **Digital Multimeter** **$74.95**

PART NO.	DESCRIPTION	PRICE
RC-3	115V AC ADAPTER	7.50
CC-3	PADDED CARRYING CASE	7.50
VP-10	X10 DC PROBE ADAPTER (Up to 10K)	14.95
VP-40	40kV DC PROBE	35.00
CS-1	10 Amp DC Current Shunt	14.95

$10.00 Min. Order — U.S. Funds Only
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The Incredible "Pennywhistle 103"



$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modern and terminal for telephone "hamming" and communications. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method	Frequency-Shift Keying, full-duplex (half-duplex selectable).
Maximum Data Rate	300 Baud.
Data Format	Asynchronous Serial (return to mark level required between each character).
Receive Channel Frequencies	2025 Hz for space; 2225 Hz for mark.
Transmit Channel Frequencies	Switch selectable: Low (normal) = 1070 space, 1270 mark; High = 025 space, 2225 mark.
Receive Sensitivity	−46 dbm accoustically coupled.
Transmit Level	−15 dbm nominal. Adjustable from −6 dbm to −20 dbm.
Receive Frequency Tolerance	Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz.
Digital Data Interface	EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar).
Power Requirements	120 VAC, single phase, 10 Watts.
Physical	All components mount on a single 5" by 9" printed circuit board. All components included.

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
★ 8 each UPD416-1 (16K Dynamic Rams) 250NS
★ Documentation for conversion

TRS-16K **$75.00**



JUST WRAP™

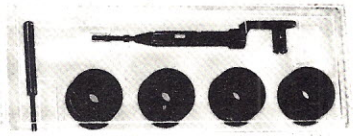
- •30 AWG wire
- •Daisy chain or point-to-point
- •.025" square posts
- •Built-in cut off
- •Includes 50 ft. wire
- •No stripping or slitting required—just wrap

Part No.	Wire Color	Price
JW-1-B	Blue	$14.95
JW-1-W	White	14.95
JW-1-Y	Yellow	14.95
JW-1-R	Red	14.95

JUST WRAP™ Replacement Wire

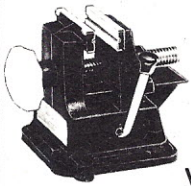
Part No.	Color		Price
R-JW-B	Blue	50 ft. roll	$2.98
R-JW-W	White	50 ft. roll	2.98
R-JW-Y	Yellow	50 ft. roll	2.98
R-JW-R	Red	50 ft. roll	2.98

JUST WRAP™ Unwrap Tool $3.49



JUST WRAP™ Kit •50 ft. ea.: blue, white, red, yellow wire •JUST WRAP Tool •Unwrapping Tool

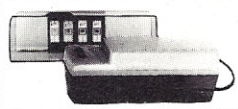
JWK-6 ..... **$24.95**



Vacuum Vise

Vacuum-based light-duty vise for small components and assemblies. ABS construction. 1½" jaws, 1¼" travel. Can be permanently installed.

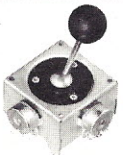
VV-1 ..... **$3.49**



EPROM Erasing Lamp

- •Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- •Erases up to 4 chips within 20 minutes.
- •Maintains constant exposure distance of one inch
- •Special conductive foam liner eliminates static build-up
- •Built-in safety lock to prevent UV exposure
- •Compact — only 7-5/8" x 2-7/8" x 2"
- •Complete with holding tray for 4 chips

UVS-11E **$69.95**



JOYSTICK

- •2 each 100K pots (Linear Taper)
- •Printed Circuit Board Mount
- •Size: 1" x 1-3/16" x 1-3/16"

JOYSTICK **$4.95**

R11

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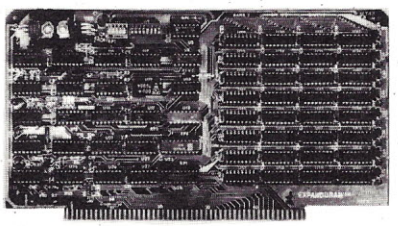
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SD EXPANDORAM

The EXPANDORAM is available in versions from 16K up to 64K, so for a minimum investment you can have a memory system that will grow with your needs. This is a dynamic memory with the invisible on-board refresh, and IT WORKS!

- Bank Selectable
- Phantom
- Power 8VDC, +16VDC, 5 Watts
- Lowest Cost Per Bit
- Uses Major Brand 16K RAMS
- PC Board is doubled solder masked and has silk-screened parts layout
- Extensive documentation clearly written



- Complete kit includes all Sockets for 64K
- Memory access time: 375ns, Cycle time: 500ns.
- No wait states required
- 16K boundaries and Protection, via Dip Switches
- Designed to work with Z-80, 8080, 8085 CPU's

EXPANDORAM 64K Kit (16K Ram)

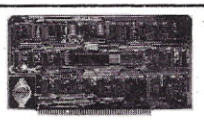
WITHOUT MEMORY	**$139.00**
16K	**209.00**
32K	**275.00**
48K	**340.00**
64K	**405.00**

SD'S PROM 100 PROM Programmer Board

The PROM-100 Programmer is a development tool for S-100 Bus computer systems. The Zero Insertion Force Programming Socket extends above the card cage height for easy access to PROM devices. Software verifies PROM erasure, verifies program loading and provides for reading of object file from Disk or PROM and programming into PROM/EPROM. Features include: On-board generated 25vdc Programming pulse, TTL compatible, maximum programming time for 16,389 bits is 100 seconds. Programs: 2708, Intel 2758, 2716, 2732 and TI 2516. DIP Selectable EPROM type.

PROM-100 Board Kit $149.95

SD'S MPB-100 Z80 CPU BOARD KIT



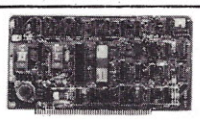
The MPB-100 provides a Z80 microprocessor based CPU for S-100 Bus systems. Front panel usage is optional, making the MPB-100 suitable for upgrading existing systems to Z80 level. A PROM socket is provided on-board which makes the MPB-100 adaptable to process control applications. Features include: Power-on Jump to 4K boundaries, 2 Megahertz or 4 Megahertz operation, optional wait states, on-board PROM socket.

MPB-100 KIT $199.00

SD'S VERSAFLOPPY II

• IBM 3740 Compatible Soft Sectored Format for Single Density Drives • Operates with Single and Dual Sided Drives, Single or Double Density Drives and 5" & 8" Drives — in any combination of four simultaneously • Drive Select and Side Select Circuitry • S-100 Bus Compatible • Vectored Interrupt Operation Optional • Phase Locked Loop Data Recovery Circuit • Operates with Z80 CPU's • Uses FD1791-1 Controller Chip • Ther Versafloppy II incorporates all the possible features of a flexible disk drive controller into one board. Capable of handling four drives simultaneously, combinations of any variety are possible, such as 5" single sided, 8" dual density dual sided, 5" dual density single sided. Most popular drives are controlled directly with the Versafloppy II. The operating system for the Versafloppy II is the extremely powerful SDOS available for SD Systems. Diagnostic and control software available to complete your disk system.

$290 KIT, $385.00 ASSEMBLED & TESTED



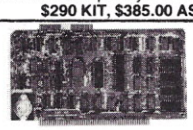
SD'S VDB-8024 VIDEO DISPLAY BOARD

The VDB-8024 features its own on-board Z80 microprocessor. This gives the capability of using software (included in ROM) to control functions and enhancements without interference with the computer's CPU. Included in the special features: 80 characters by 24 lines display, keyboard power and interface, composite and separate video output, 2K on-board RAM, a total of 256 available characters, full cursor control, forward and reverse scrolling, underlining, field reverse, field protect enhancements, programmable characters. **VDB-8024 KIT $289.00**

SD'S "VERSAFLOPPY I" KIT

FEATURES: IBM 3740 soft sectored compatible, S-100 BNS Compatible for Z-80 or 8080. Controls up to 4 drives (single or double sided). Directly controls the following drives: Sugart SA400/450 Mini Floppy • Shugart SA800/850 Standard Floppy • PERSCI 70 and 277 • MFE 700/750 • CDC 9404/9406

$135.00



SD'S SBC-100 SINGLE BOARD COMPUTER

The SBC-100 provides a complete micro-computer on a single board! The Z80 microprocessor is used as the heart of the SBC-100. The SBC-100 meets all the requirements of a Z80 CPU board with the added features of I/O ports, counter/timer channels, on board RAM, provisions for PROM/ROM and a software programmable baud rate generator. S-100 Bus compatible, the SBC-100 features are: 8K bytes of available PROM, 1024 bytes on-board RAM, Serial I/O with both synchronous and asynchronous operation, Parallel I/O ports, Operational Vectored Interrupts, and Four Counter/Timer Channels. SD Monitor available for RS-232 and Video Terminals. Disk based system software also available.

SBC-100 KIT $209.00

TARBELL FLOPPY DISK INTERFACE

Compatible with Z80 & 8080. S-100 Bus. Uses CPM operating system. Plugs directly into your IMSAI or ALTAIR • Fastest transfer rate

KIT $190.00 Assembled & Tested $260.00

TARBELL CASSETTE INTERFACE

Plugs directly into your IMSAI or ALTAIR • Fastest transfer rate • Extremely reliable • Phase encoded • 4 extra status & control lines

KIT $99.95

COMPUTER CORNER

CPU'S

Z80	$10.99

RELATED CHIPS

2114 (300ns)	$5.99
Z80 PIO	$9.95
2708	**$7.99**
4115	8/$34.95
4116	8/$80.00

DISC CONTROLLER

1771	$29.95
1791	**$37.95**

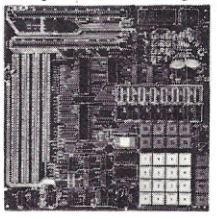
IC SOCKETS

SOLDER TIN PIN		LOW PROFILE PIN	
8	.12	16	.17
14	.15	18	.24
24	.32	40	.54
28	.39	20	.26

Z80 STARTER KIT

Kit: $219.95 Assembled & Tested $369.95

SD System's Z80 Starter Kit enables the novice to build a complete microcomputer on a single board. Featuring the powerful Z80 microprocessor, the Z80 Starter Kit features • Keyboard and Display • Audio Interface • PROM Programmer • Expansion and Wire Wrap Area • On Board RAM • 4 Channel Counter/Timer • Z-BUG Monitor in PROM • I/O Ports.



DIP SWITCHES

3 Pos.	**$1.10**
4 Pos.	**$1.12**
5 Pos.	**$1.16**
6 Pos.	**$1.20**
7 Pos.	**$1.22**
8 Pos.	**$1.26**
9 Pos.	**$1.36**
10 Pos.	**$1.30**

LEDS AND READOUT

Jumbo Red LED's	**8/1.00**
Jumbo Green LED's	**4/.95**
Jumbo Yellow LED's	**4/.95**
Jumbo Amber LED's	**4/.95**
MV Red	**10/1.00**
FND 70CC	**.50**
DL 707	**.95**
DL 747CA	.65
DL 728CC	**1.19**
FND 800CC	**1.50**
Red Filter 4" Bezel	**2.50**
Green Filter 4" Bezel	**2.50**
Amber Filter 4" Bezel	**2.50**
4N25	**1.60**
4N26	**1.25**
4N27	**1.10**
4N28	**.95**
4N31	**1.20**

S-100 CONNECTORS

High-Quality Gold Pins

$2.99 EACH

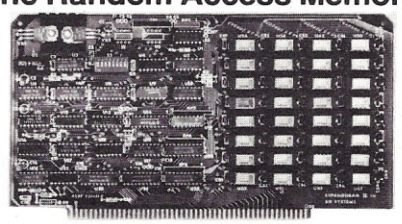
FLOPPY DISK SPECIAL

5.25" SOFT, 10 OR 16 SECTOR
10 FOR $29.95
8" SOFT SECTORED IBM COMPATIBLE
10 FOR $34.95

SD'S EXPANDORAM II

The Randem Access Memory

- S-100 Bus Compatible
- Up to 4Mhz Operation
- Expandable Memory from 16K to 256K
- DIP Switch Selectable Boundaries
- Uses 16K (4116) or 64K (4164) Memory Devices
- Page Mode Operation Allows up to 8 Memory Boards on Bus
- Operates with Z80 CPU's
- Phantom Output Disable
- Invisible Refresh (Synchronized with Wait States)



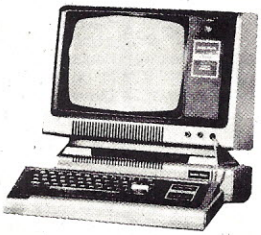
SD Systems' ExpandoRAM II is a dynamic RAM board with capacities from 16K bytes (4116) to 256K bytes (4164). It operates on the industry S-100 Bus. The design allows 8 boards to operate from the same S-100 Bus. The ExpandoRAM II is compatible with most S-100 CPU's based on the Z80 microprocessor.

EXPANDORAM II KIT

W/O	**$195.00**
16K	**285.00**
32K	**375.00**
48K	**465.00**
64K	**555.00**

Try to beat our prices!

10% OFF



Radio Shack TRS-80 and accessories (full warranty)

NORTH STAR HORIZONS IN STOCK!
PRICES GOING UP
CALL FOR SUPER VALUES

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MORROW THINKER TOYS® Discus 2D, List $1149 . . . . . OUR PRICE $979
Discus 2D, dual-drive, List $1948 $1658
Discus 2+2, A&T, List $1549 . . . . $1319
Dual Discus 2+2, A&T, List $2748 . $2335
MICROMATION Megabox, double-density w/ 8" drives, 1-megabyte, List $2295 . $1949
2-megabyte, List $3095 . . . . . $2629
MICROPOLIS 1041 MacroFloppy® in enclosure (power source & regulator board required), List $695 . . . . . $625
1042 MacroFloppy w/case & AC P.S. . $709
1053 Dual MetaFloppy®, List $1895 . $1695

VIDEO BOARDS

SD COMPUTER VDB-8024 Video Display Bd, I/O mapped, kit, $319 . . $279
Assembled, List $469 . . . . . $399
VECTOR GRAPHICS Flashwriter®
FW-64 memory mapped, A&T, $235
FW-80U/LC 80-char. line, A&T, $320
XITEX SCT-100K, Kit . . . ONLY $154.95
SCT-100A Assembled $174.95
SSM VB1B Memory Mapped Video Interface, 16x64, Kit, List $149 . . . $126
Assembled & Tested, List $199 . . . . $169
SSM VB2 I/O Mapped Video Interface Kit, List $159 . . . . . $135
Assembled & Tested, List $224 . . . . $190
ITHACA AUDIO Memory Mapped Video Board, 16x64, A&T, List $165 . $149

CALL FOR PRICE: Vector MZ, Exidy Sorcerer, Dynabyte, Intertec SuperBrain

CPU BOARDS

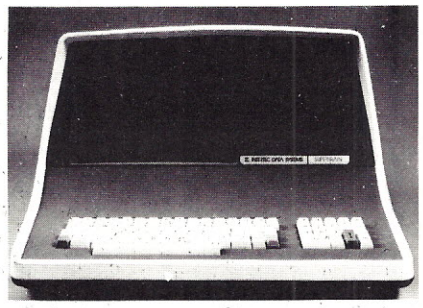
NORTH STAR Z80A Processor Board A&T (ZPB-A/A), List $259 . . . . . $209
CROMEMCO 4MHz CPU Card A&T (ZPU-W), List $395 . . . . . $335
CROMEMCO 4 MHz Single Card Computer A&T, List $450 . . . . . $382
VECTOR GRAPHIC Z-80 CPU Board A&T, ... $215
ITHACA AUDIO Z-80 CPU Board, 4 MHz A&T, List $205 . . . . . $179
2 MHz, A&T, List $175 . . . . . $155
DELTA Z-80 CPU with I/O, A&T . . . $239
SD Single Card Computer (SBC-100) Kit, List $239 . . . . . $210
A&T, List $369 . . . . . $329

MEMORY BOARDS

NORTH STAR 16K Dynamic RAM Board, Kit (RAM-16-A), List $399 . . . . . $269
A&T (RAM-16-A/A), List $459 . . . $309
32K Kit (RAM-32), List $599 . . . . $499
32K A&T (RAM-32/A), List $659 . . $549
CROMEMCO RAM Card w/bank select, A&T 16K (16KZ-W), List $595 . . . . . $495
64K (64KZ-W), List $1795 . . . . . $1485
MEASUREMENT SYSTEMS & CONTROLS Guaranteed performance, incl. labor/parts 1 yr
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DM3200 with 32K, List $595 . . . $509
DM1600 with 16K, List $495 . . . $429
DM0000 with no RAM, $395 . . . . $349
THE DMB SERIES –
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DMB4800 with 48K $789
DMB3200 with 32K $709
MORROW SuperRAM, A&T
16K Static Board, 4 MHz, List $349 . $299
32K Static Board, 4 MHz, List $699 . $629
VECTOR GRAPHIC, 8K Static, A&T . $189
SD ExpandoRAM w/o RAMS $139
32K Dynamic with 8K, Kit $189
32K Dynamic with 16K, Kit $237
32K Dynamic with 32K, Kit $329
ITHACA AUDIO 8K Static 250ns,A&T $175

FLOPPY DISK CONTROLLER BOARDS

MORROW Disk Jockey 1, A&T ($213) . $189
Disk Jockey 2D, A&T, List $479 . . . $429
SD Versafloppy I, Kit, List $159 . . . $139
Versafloppy II, d-d, Kit, List $309 . . $265
Versafloppy II, d-d, A&T, List $399 . $359
DELTA double density A&T ($385) . $345
CONDUCTOR, double density A&T . . $269
ITHACA AUDIO, A&T, List $175 . . . $155
MICROMATION Doubler, double density Controller Board, A&T, List $495 $399
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double density, Kit, List $325 . . . . $295
double density, A&T, List $425 . . . $380



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Complete computer, totally self-contained in a single box. 32K, 48K, or 64K versions. Uses two Z-80 CPU's. Commercial-type terminal w/12" monitor. Dual double-density minifloppies with 320 kilobytes of storage capacity. I/O port included. Expandable with an external S-100 bus interface. Comes with CP/M operating system. Extensive software support.

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INTERTUBE II, List $995 . . . ONLY $799
PERKIN-ELMER 550, List $997 . . . . $799
with anti-glare screen, $1027 . . . . $819
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1420 . . . . . $849
1500, List $1225 . . . . . $989
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1510, List $1395 . . . . . $1089
1520, List $1650 . . . . . $1389
ADDS R-20, List $995 . . . . . $945
R-100, List $1325 . . . . . $1295
LEAR SIEGLER ADM3A Kit $775
ADM3A Assembled $849
ADM31, List $1450 . . . . . $1295
ADM42, List $1795 . . . . . $1595
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IQ140, List $1495 . . . . . $1249
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w/graphics op., incl. buffer, $1194 . $1069
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702-2 w/tractor VFU, List $2480 . . 1995

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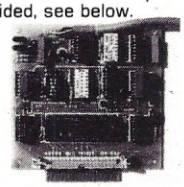
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TRS-80 E.S. SERIAL I/O

• Can input into basic • Can use LLIST and LPRINT to output, or output continuously • RS-232 compatible • Can be used with or without the expansion bus • On board switch selectable baud rates of 110, 150, 300, 600, 1200, 2400, parity or no parity odd or even, 5 to 8 data bits, and 1 or 2 stop bits. D.T.R. line • Requires +5, -12 VDC • Board only $19.95 Part No. 8010, with parts $59.95 Part No. 8010A, assembled $79.95 Part No. 8010 C. No connectors provided, see below.



EIA/RS-232 connector Part No. DB25P $6.00, with 9', 8 conductor cable $10.95 Part No. DB25P9.

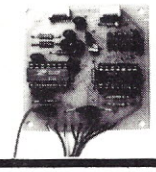


3' ribbon cable with attached connectors to fit TRS-80 and our serial board $19.95 Part No. 3CAB40.



MODEM

• Type 103 • Full or half duplex • Works up to 300 baud • Originate or Answer • No coils, only low cost components • TTL input and output-serial • Connect 8 Ω speaker and crystal mic. directly to board • Uses XR FSK demodulator • Requires +5 volts • Board only $7.60 Part No. 109, with parts $27.50 Part No. 109A



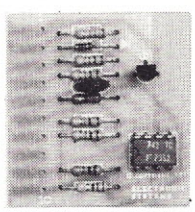
DISKETTES



Box of 10, 5" $29.95, 8" $39.95. Plastic box, holds 10 diskettes, 5" - $4.50, 8" - $6.50.

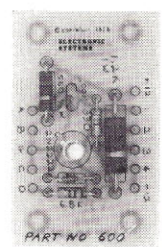
RS-232/ TTL INTERFACE

• Converts TTL to RS-232, and converts RS-232 to TTL • Two separate circuits • Requires -12 and +12 volts • All connections go to a 10 pin gold plated edge connector, kit $ 9.95 Part No. 232A 10 Pin edge connector $3.00 Part No. 10P.



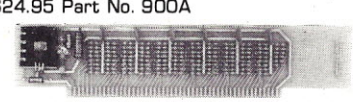
RS-232/TTY INTERFACE

This board has two active circuits, one converts RS-232 to 20mA, and the other converts 20mA to RS-232. Requires +12 and -12 volts. $9.95 Part No. 600A Kit.

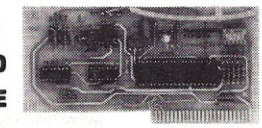


S-100 BUS ACTIVE TERMINATOR

Board only $14.95 Part No. 900, with parts $24.95 Part No. 900A



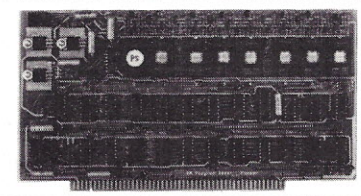
APPLE II* SERIAL I/O INTERFACE



Baud rate is continuously adjustable from 0 to 30,000 • Plugs into any peripheral connector • Low current drain. RS-232 input and output • On board switch selectable 5 to 8 data bits, 1 or 2 stop bits, and parity or no parity either odd or even • Jumper selectable address • SOFTWARE • Input and Output routine from monitor or BASIC to teletype or other serial printer • Program for using an Apple II for a video or an intelligent terminal. Also can output in correspondence code to interface with some selectrics. • Also watches DTR • Board only $15.00 Part No. 2, with parts $42.00 Part No. 2A, assembled $62.00 Part No. 2C

8K EPROM PIICEON

Saves programs on PROM permanently (until erased via UV light) up to 8K bytes. Programs may be directly run from the program saver such as fixed routines or assemblers. • S-100 bus compatible • Room for 8K bytes of EPROM non-volatile memory (2708's). • On-board PROM programming • Address relocation of each 4K of memory to any 4K boundary within 64K • Power on jump and reset jump option for "turnkey" systems and computers without a front panel • Program saver software available • Solder mask both sides • Full silkscreen for easy assembly. Program saver software in 1 2708 EPROM $25. Bare board $35 including custom coil, board with parts but no EPROMS $139, with 4 EPROMS $179, with 8 EPROMS $219.



WAMECO PRODUCTS WITH ELECTRONIC SYSTEMS PARTS

FDC-1 FLOPPY CONTROLLER BOARD will drive shugart, pertek, remex 5" & 8" drives up to 8 drives, on board PROM with power boot up, will operate with CPM (not included). PCBD $42.95

FPB-1 Front Panel. (Finally) IMSAI size hex displays. Byte or instruction single step. PCBD $42.95

MEM-1A 8Kx8 fully buffered, S-100, uses 2102 type RAMS. PCBD ..... $24.95, $168 Kit

QMB-12 MOTHER BOARD, 13 slot, terminated, S-100 board only ..... $34.95 $89.95 Kit

CPU-1 8080A Processor board S-100 with 8 level vector interrupt PCBD .. $25.95 $89.95 Kit

RTC-1 Realtime clock board. Two independent interrupts. Software programmable. PCBD ..... $25.95, $60.95 Kit

EPM-1 1702A 4K EPROM card PCBD ..... $25.95 $49.95 with parts less EPROMS

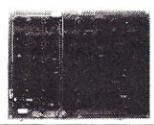
EPM-2 2708/2716 16K/32K EPROM card PCBD ..... $24.95 $49.95 with parts less EPROMS

QMB-9 MOTHER BOARD. Short Version of QMB-12. 9 Slots PCBD ..... $30.95 $67.95 Kit

MEM-2 16Kx8 Fully Buffered 2114 Board PCBD ..... $25.95, $269.95 Kit

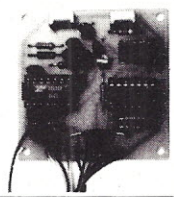
T.V. TYPEWRITER

• Stand alone TVT • 32 char/line, 16 lines, modifications for 64 char/line included • Parallel ASCII (TTL) input • Video output • 1K on board memory • Output for computer controlled curser • Auto scroll • Non-destructive curser • Curser inputs: up, down, left, right, home, EOL, EOS • Scroll up, down • Requires +5 volts at 1.5 amps, and -12 volts at 30 mA • All 7400, TTL chips • Char. gen. 2513 • Upper case only • Board only $39.00 Part No. 106, with parts $145.00 Part No. 106A



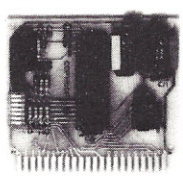
TAPE INTERFACE

• Play and record Kansas City Standard tapes • Converts a low cost tape recorder to a digital recorder • Works up to 1200 baud • Digital in and out are TTL-serial • Output of board connects to mic. in of recorder • Earphone of recorder connects to input on board • No coils • Requires +5 volts, low power drain • Board only $7.60 Part No. 111, with parts $27.50 Part No. 111A



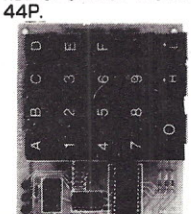
UART & BAUD RATE GENERATOR

• Converts serial to parallel and parallel to serial • Low cost on board baud rate generator • Baud rates: 110, 150, 300, 600, 1200, and 2400 • Low power drain +5 volts and -12 volts required • TTL compatible • All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity. • All connections go to a 44 pin gold plated edge connector • Board only $12.00 Part No. 101, with parts $35.00 Part No. 101A, 44 pin edge connector $4.00 Part No. 44P



HEX ENCODED KEYBOARD E.S.

This HEX keyboard has 19 keys, 16 encoded with 3 user definable. The encoded TTL outputs, 8-4-2-1 and STROBE are debounced and available in true and complement form. Four onboard LEDs indicate the HEX code generated for each key depression. The board requires a single +5 volt supply. Board only $15.00 Part No. HEX-3, with parts $49.95 Part No. HEX-3A. 44 pin edge connector $4.00 Part No. 44P.



DC POWER SUPPLY

• Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp. • Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps. • Board only $12.50 Part No. 6085, with parts excluding transformers $42.50 Part No. 6085A



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E21

COMPUCRUISE

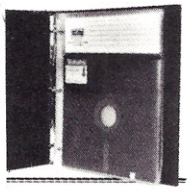
Put a computer in your car, which gives you the most effective and functional cruise control ever designed, plus complete trip computing, fuel management systems, and a remarkable accurate quartz crystal time system.

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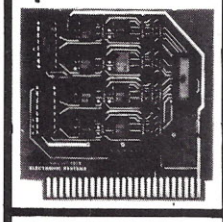
FLOPPY DISK STORAGE BINDER

This black vinyl three-ring binder comes with ten transparent plastic sleeves which accommodate either twenty, five-inch or ten, eight-inch floppy disks. The plastic sleeves may be ordered separately and added as needed. A contents file is included with each sleeve for easy identification and organizing. Binder & 10 holders $14.95 Part No. B800; Extra holders 95¢ each. Part No. 800



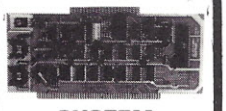
OPTO-ISOLATED PARALLEL INPUT BOARD FOR APPLE II

There are 8 inputs that can be driven from TTL logic or any 5 volt source. The circuit board can be plugged into any of the 8 sockets of your Apple II. It has a 16 pin socket for standard dip ribbon cable connection.
Board only $15.00. Part No. 120, with parts $69.95. Part No. 120A.



TIDMA

• Tape Interface Direct Memory Access • Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate • S-100 bus compatible • Board only $35.00 Part No. 112, with parts $110 Part No. 112A

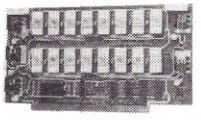


SYSTEM MONITOR

8080, 8085, or Z-80 System monitor for use with the TIDMA board. There is no need for the front panel. Complete with documentation $12.95.

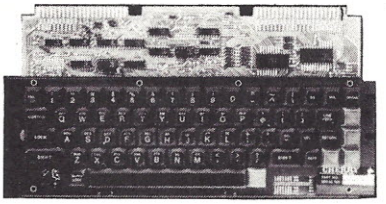
16K EPROM

Uses 2708 EPROMS, memory speed selection provided, addressable anywhere in 65K of memory, can be shadowed in 4K increments. Board only $24.95 part no. 7902, with parts less EPROMs $49.95 part no. 7902A.



ASCII KEYBOARD

TTL & DTL compatible • Full 67 key array • Full 128 character ASCII output • Positive logic with outputs resting low • Data Strobe • Five user-definable spare keys • Standard 22 pin dual card edge connector • Requires +5VDC, 325 mA. Assembled & Tested. Cherry Pro Part No. P70-05AB. $119.95.



ASCII KEYBOARD

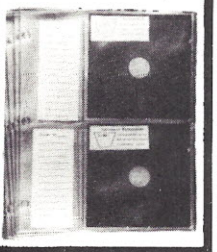
53 Keys popular ASR-33 format • Rugged G-10 P.C. Board • Tri-mode MOS encoding • Two-Key Rollover • MOS/DTL/TTL Compatible • Upper Case lockout • Data and Strobe inversion option • Three User Definable Keys • Low contact bounce • Selectable Parity • Custom Keycaps • George Risk Model 753. Requires +5, -12 volts. $59.95 Kit.

ASCII TO CORRESPONDENCE CODE CONVERTER

This bidirectional board is a direct replacement for the board inside the Trendata 1000 terminal. The on board connector provides RS-232 serial in and out. Sold only as an assembled and tested unit for $229.95. Part No. TA 1000C

DISK JACKET™

Made from heavy duty .0095 matte plastic with reinforced grommets. The mini-diskette version holds two 5-1/4 inch diskettes and will fit any standard three ring binder. The pockets to the left of the diskette can be used for listing the contents of the disk. Please order only in multitudes of ten. $9.95/10 Pack.



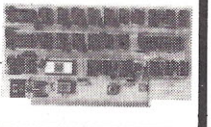
ATARI 800

Computer with 8K $995.00, disk drive $549.00, printer $599.99



VIDEO TERMINAL

16 lines, 64 columns • Upper and lower case • 5x7 dot matrix • Serial RS-232 in and out with TTL parallel keyboard input • On board baud rate generator 75, 110, 150, 300, 600, & 1200 jumper selectable • Memory 1024 characters (7-21L02) • Video processor chip SFF96364 by Neculonic • Control characters (CR, LF, →, ←, ↑, ↓, non destructive cursor, CS, home, CL • White characters on black background or vice-versa • With the addition of a keyboard, video monitor or TV set with TV interface (part no. 107A) and power supply this is a complete stand alone terminal • also S-100 compatible • requires +16, & −16 VDC at 100mA, and 8VDC at 1A. Part No. 1000A $199.95 kit.



RS-232/20mA INTERFACE

This board has two passive, opto-isolated circuits. One converts RS-232 to 20mA, the other converts 20mA to RS-232. All connections go to a 10 pin edge connector. Requires +12 and -12 volts. Board only $9.95, part no. 7901, with parts $14.95 Part No. 7901A.



COMPUCOLOR II

Model 3, 8K $13 95, Model 4, 16K $15 95, Model 5, 32K $18 95. Prices include color monitor, computer, and one disk drive.



PET COMPUTER

With 32K & monitor - $1195. Dual Disk Drive - $1195.



apple II or APPLE II PLUS

16K - $995 , 32K - $1059, 48K - $1123. Disk & cont. $589



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16K RAMS

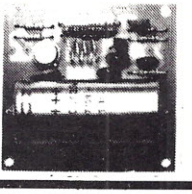
For the Apple, TRS-80 or Pet $8 each Part No. 4116/2117.

APPLE II HOBBY/PROTOTYPING CARD

$14.95 Part No. 7907

T.V. INTERFACE

● Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple ● Power required is 12 volts AC C.T., or +5 volts DC ● Board only $7.60 part No. 107, with parts $13.50 Part No. 107A





PARALLEL TRIAC OUTPUT BOARD FOR APPLE II

This board has 8 triacs capable of switching 110 volt 6 amp loads (660 watts per channel) or a total of 5280 watts. Board only $15.00 Part No. 210, with parts $119.95 Part No. 210A.

To Order: Mention part no. description, and price. In USA shipping paid by us for orders accompanied by check or money order. We accept C.O.D. orders in the U.S. only, or a VISA or Master Charge no., expiration date, signature, phone no., shipping charges will be added. CA residents add 6.5% for tax. Outside USA add 10% for air mail postage and handling. Payment must be in U. S. dollars. Dealer inquiries invited. 24 hour order line (408) 448-0800

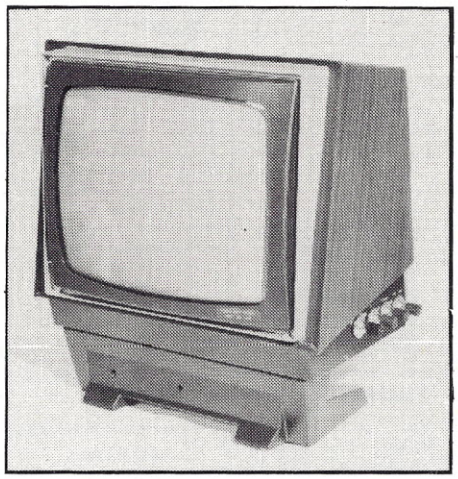
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✓ Reader Service index—page 241

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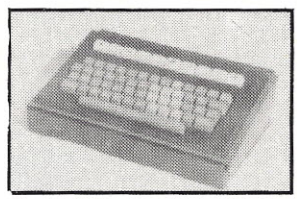
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SPECIAL

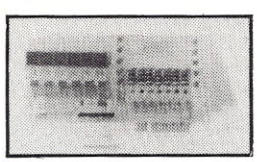
Microprocessor Chips #6502
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- Model 101A, 60 to 200 lines/minute
- 165 characters/second
- 132 characters/line
- 9 × 7 dot matrix pattern

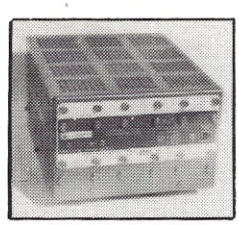
All models feature fixed vertical/horizontal registration; remote select/deselect; elongate bold face characters (line by line); vertical format unit; two channel VFU; prints originals plus four copies; 8 bit ASCII parallel data input; paper runaway inhibit; audio alarm; printing methods include impact character by character one line at a time.

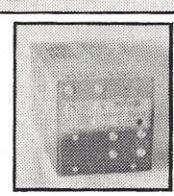
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Bare Board w/all parts less mem. 99.95

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ASSEMBLED			
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Bare PC Board w/Data $21.95
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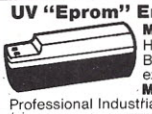


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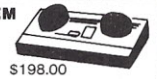
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6530-002	15.50
6530-003	15.50
6530-004	15.50
6530-005	15.50

DYNAMIC RAMS

416/4116 16K (16 Pin)	9.95
Set of 8 416's	74.95
4115 8K (16 Pin)	6.75
4050 4K x 1 (18 Pin)	4.25
4060 4K x 1 (22 Pin)	4.95
4096 4K x 1 (16 Pin)	3.95
2104 4K x 1 (16 Pin)	4.75
4027 4K x 1 (16 Pin)	4.95
5261 1.95	1103 1.95
5262 1.95	4008L 4.95
5270 4.95	6605 7.95
5280 4.95	6604 4.95
5290 12.45	6002 1.50

PROMS

2708	9.95
2708-6	7.50
1702A	3.95
2732	99.00
2716-5V	44.95
2716-5V, 12V	29.95
2758 5V	29.95
5203AQ	11.95
5204AQ	9.95
6834-1	12.95
IM 5610	2.95
SALE 8223 32 x 8	**2.95**
82S115 512 x 8 (TS)	16.95
82S123 32 x 8	2.50
82S126 256 x 4	3.50
82S129 256 x 4 (TS)	3.50
82S130 512 x 4 (OC)	6.50
NSC DM7578 32 x 8	2.95

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2513-001 (5V) Upper	9.50
2513-005 (5V) Lower	10.95
2513-ADM3 (5V) Lower	14.95
MCM6571	10.75
MCM6571A	10.75
MCM6574	14.50
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TR1602B (5V, 12V)	3.95
AY51013 (5V, 12V)	4.95
AY51014A/1612 (5-14V)	6.95
AY51015A/1863 (5V)	6.95
TMS 6011 (5V, 12V)	5.50
IM6402	7.95
IM6403	8.95
2350 USRT	9.95
1671B Astros	24.95
SALE TR1472B	**9.95**

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4702	14.95
WD1941	9.95

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AY5-2376	13.75
AY5-3600	13.75
HD0165	9.95
74C922	9.95
74C923	9.95

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8700 8 bit Binary	13.50
8701 10 bit Binary	22.00
8703 8 bit TS	13.50
9400 Volt to Freq. Conv.	7.25
8750 3-1/2 Digit BCD	13.95
1408L6 6 bit	3.95
1408L8 8 bit	5.95
DACOI A/D	5.95

STATIC RAM HEADQUARTERS

	1-24	25-99	100
21L02 450ns.	1.30	1.25	1.15
21L02 250ns.	1.59	1.55	1.45
2102	1.25	1.15	1.10
2111	3.75	3.65	3.55
2112-1	2.95	2.85	2.65
2101-1	2.90	2.70	2.55
2114L-250ns.	12.95	10.95	9.95
2114L-300ns.	8.95	7.95	6.45
2114L-450ns.	7.50	6.75	**4.75**
4044/4041 300ns.	9.95	8.75	7.95
4044/4041 450ns.	7.50	6.75	**4.75**
EMM4200A	9.75	8.75	7.95
EMM4402	7.95	7.25	6.25
EMM4804	12.50	11.50	9.95
5101C-E	7.95	7.95	7.25
upd410 (4200i)	10.95	10.25	9.25
AMD9140/41	10.95	10.25	9.25
AMD9130/31	12.95	11.95	10.25

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1101	1.95	1.75	1.25
P2125/93425 (45 ns.)	7.95	7.35	7.25
6508 1K x 1 CMOS	7.95	7.95	7.25
6518 1K x 1 CMOS	7.95	7.95	7.25
74S189 64 bit Ram	3.95	3.25	2.50

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16K CCD - First time offered Fairchild 460 CCD 16K Memory (now you can experiment with CCD technology at a reasonable price. 17 page Application note supplied with each order. Quantity limited)

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Microprocessor Timebases TV Game

Frequency	Price	Frequency	Price
1.0MHz	$5.85	6.0MHz	$ 4.95
1.8432	4.95	6.144	4.95
2.0MHz	5.85	6.5536	4.95
2.01MHz	2.95	10.0MHz	4.95
2.097152MHz	5.85	13.0MHz	4.95
2.45760MHz	5.85	14.31818	4.95
3.579545MHz	1.50	18.0MHz	4.95
4.0MHz	4.95	18.432MHz	5.95
4.194304MHz	5.95	20.0MHz	4.95
4.91520MHz	5.95	22.1184MHz	5.95
5.0MHz	4.95	27.0MHz	5.95
5.0688	4.95	36.0MHz	5.95
5.7143MHz	5.95	48.0MHz	5.95
		100KC	12.95

DISPLAYS/OPTO/LED'S

★ 7 SEGMENT ★ CALC ★ CLOCKS ★

DL 704 (CC), DL 707 (CA) .300" Red ..... .99
FND 357 (CC) .357" Red ..... .99
FND 500/503 (CC) .500" Red ..... .99
FND 507/510 (CA) .500" Red ..... .99
FND 800/803 (CC) .800" Red 1.75
FND 807/810 (CA) .800" Red 1.75
XAN 3062 .500" Green 1.15
HP5082-7731 (CA) .300" Red ..... .99
9 Digit Bubble Mini Calc. Display ..... .99
9 Digit Panaplex Display .400" ..... .99
9 Digit Fluorescent .300" ..... .99
MA1003 12V Auto Clock Module **15.95**
Bezel for MA1003 w/Red Filter 4.95
MA1002A LED 12 hr. Clock Module **10.95**

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HP 5082-7300 Red Numeric 14.95
TIL 306 Numeric w/Logic 8.95
TIL 308 Number w/Logic 8.95
TIL 309 Number w/Logic 8.95
TIL 311 Hexadecimal 12.95
MAN 2A .320" Red Alpha-Numeric 5.95
MAN 10A .270" Red Alpha-Numeric 8.95

SOCKETS

8 Pin W/W	32	8 Pin S/T	17
14 Pin W/W	37	14 Pin S/T	20
16 Pin W/W	38	16 Pin S/T	22
18 Pin W/W	60	18 Pin S/T	31
20 Pin W/W	90	20 Pin S/T	34
22 Pin W/W	93	22 Pin S/T	35
24 Pin W/W	85	24 Pin S/T	41
28 Pin W/W	1.15	28 Pin S/T	49
40 Pin W/W	1.49	40 Pin S/T	63

TEXTOOL ZERO INSERTION FORCE SOCKETS

16 Pin $ 5.50 24 Pin $7.50
40 Pin $10.25

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DB25P (RS232) 3.25
DB25S Female 3.75
Hood 1.25
Set w/Hood, Sale $6.50
22/44 W/W, S/T, KIM 2.95
43/86 W/W, S/T, MOT 6.50
50/100 S-100 Connector w/w 4.25
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CTS206-5 $1.75 CTS206-9 $1.95
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8080A CPU	34.95
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32K Static RAM (2114)	49.95
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2708/2716 Eprom (Ithaca)	34.95
2708/2716 Eprom (WMC)	30.00
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9 Slot MotherBoard (WMC)	29.95
8 Slot Mother (expandable)	34.85

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1771-01 8" & Minifloppy	27.95
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1781 Dual Floppy	29.95
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21L02-4 (450 ns) 100 @ 99¢ ea.
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1488 Line Receiver 100 @ 75¢ ea.
1489 Line Driver 100 @ 75¢ ea.
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1496 L Demodulator 25 @ 75¢ ea.
LM 3900 Quad Op Amp 3/$1.99
2716 5 Volts EPROM 3/$99.00

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	LIST	SALE		LIST	SALE
Apple II Plus w/16K	1195.	990.	IPSI 1620 Diable RO	3295.	2695.
PET 2001-16N	995.	895.	Anadex DP 8000	995.	895.
Exidy Sorcerer w/8K	895.	795.	Centronics Micro P-1	595.	395.
Compucolor II w/8K	1495.	1395.	Centronics Micro S-1	595.	525.
Cromemco Sys III	5990.	4990.	Soroc IQ 120	995.	850.
Horizon I w/16K	1599.	1349.	Teletype Model 43	1349.	1150.
TEI PI208 w/32K dual floppy & CRT (1 avail.)	4995	2995	HiPlot Plotter	1085.	899.
			HiPlot Digitizer	795.	735.
Pascal Microengine	2995	2395	Intertube II	895.	784.
			Proc. Tech. SOL-20		$1095.

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ICM7207 Oscillator Controller 6.95
ICM7045 Precision Sto/Watch Timer 22.95
ICL7107 3½ Digit A/D (LED) 14.95
ICL8211 Voltage Reference 1.95
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LM1800 Phase Lock Loop FM Stereo 3/1.00
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DS3625 Dual Mos Sense Amp 2.50

1408L8	4/19.95	10147 ECL Ram	9.95
1488/1489	2/1.99	LF356HBiFet	3/1.99
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MK5014 Calc.	2/1.99	74107N	6/1.99
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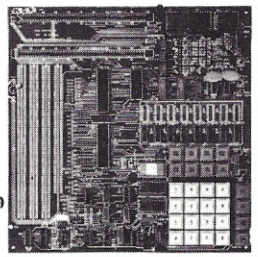
RC-3 115V AC Adapter $7.50
CC-3 Deluxe Padded Vinyl Carrying Case $7.50
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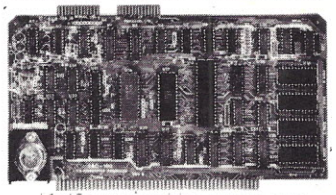
Z80 STARTER KIT
A Complete Microcomputer On A Board

- Z80 CPU with 158 Instructions
- On-Board Keyboard and Display
- On-Board PROM Programmer for Single Voltage PROMS (2716, 2758, TI2516)
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SDS-Z80 STARTER KIT.....$219.00
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SINGLE BOARD COMPUTER

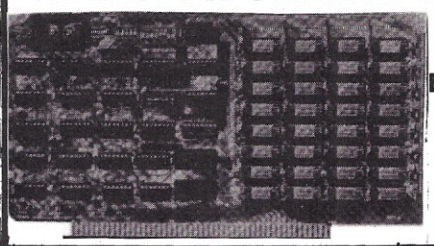


With On-Board RAM, PROM, CTC

- S-100 Bus Compatible
- Z80 Central Processing Unit
- 1024 Bytes of Random Access Memory
- 8K Bytes of PROM using 2716
- Parallel Input and Output Ports
- Four Channel Counter/Timer (Z80-CTC)
- Software Programmable Baud Rate Generator
- No Front Panel Required for Operation

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SD EXPANDORAM *The Ultimate S-100 Memory*



The EXPANDORAM is available in versions from 16K up to 64K, so for a minimum investment you can have a memory system that will grow with your needs. This is a dynamic memory with the invisable on-board refresh, and IT WORKS!

- Interfaces with Altair, IMSAI, SOL-8, Cromenco, SBC-100, and others.
- Bank Selectable
- Phantom
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- Lowest Cost Per Bit
- Uses Popular 4116 RAMS
- PC Board is doubled solder masked and has silk-screen parts layout.
- Extensive documentation clearly written
- Complete Kit includes all Sockets for 64K
- Memory access time: 375ns, Cycle time: 500ns.
- No wait states required.
- 16K boundries and Protection via Dip Switches
- Designed to work with Z-80, 8080, 8050 CPU's

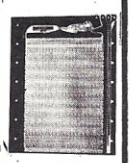
EXPANDO 64 KIT (4116):

	Reg. Price	Sale Price
16K	$249	$198.00
32K	$324	$262.00
48K	$399	$335.00
64K	$474	$390.00

- Kit includes 12 tantalum capacitors for +5, +12, —12 buses and insulated mounting spacers.
- Wiring side shown. Component side bare epoxy glass with white markings for component locations.
- G10 epoxy glass board with 2 ounce copper, solder plated and .038 diameter holes for leads.
- Solder mask with solder windows on etched circuits to avoid accidental short circuits.
- Mounts 11 receptacles with 100 contacts (2 rows) on .125 centers with .250 row spacing. Vector part number R681-2; or mounts 10 receptacles plus interconnections to smaller mother board for expansion.
- Includes etched circuits and instructions for option of active, pull-up, or floating terminators.
- Large buses: +5V and GND (10 AMPS), ±12V or 16V (7 AMPS). Current ratings are per MIL-STD-275 with 10°C rise.
- Fits in Vector-pak enclosures.
- Fits in IMSAI 8080 microcomputer as expander board.

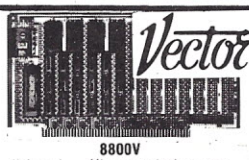
8803 MOTHER BOARD FOR S100 BUS MICRO-COMPUTERS

Vector



Price: $29.50

Vector



8800V

Universal Microcomputer/processor plugboard, use with S-100 bus. Complete with heat sink & hardware. 5.3" x 10" x 1/16"

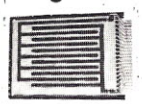
1-4	5-9	10-24
$19.95	$17.95	$15.96

8801-1

Same as 8800V except plain; less power buses & heat sink.

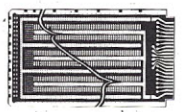
1-4	5-9	10-24
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Plugboards



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3682-2 6.5" x 4.5"
$9.81

Hi-Density Dual-In-Line Plugboard for Wire Wrap with Power & Grd. Bus Epoxy Glass 1/16" 44 pin con. spaced .156



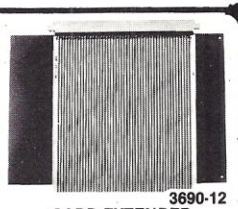
3677 9.6" x 4.5"
$10.90
3677-2 6.5" x 4.5"
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Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin con. spaced .156



3662 6.5" x 4.5"
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3662-2 9.6" x 4.5"
$11.45

P pattern plugboards for IC's Epoxy Glass 1/16" 44 pin con. spaced .156



3690-12
CARD EXTENDER

Card Extender has 100 contacts 50 per side on .125 centers-Attached connector-is compatible with S-100 Bus Systems. **$25.83**
3690 6.5" 22/44 pin .156 ctrs. Extenders $13.17



1/16 Vector BOARD
.042 dia holes on 0.1 spacing for IC's

Phenolic PART NO.	SIZE	PRICE 1-9	10-19
64P44XXXP	4.5x6.5"	$1.56	$1.40
169P44XXXP	4.5x17"	$3.69	$3.32
Epoxy Glass			
64P44	4.5x6.5"	$1.79	$1.61
84P44	4.5x8.5"	$2.21	$1.99
169P44	4.5x17"	$4.52	$4.07
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1,000's SETS SOLD! **4116's RAMS** GUARANTEED 100%
from Leading Manufacturers
(16Kx1 200/250ns)

8 for $75.00

Add $3.00 for programming Jumpers for TRS-80 Keyboard

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Part No.	Sides/ Density	Sectoring	Price Box of 10
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740/2-OP	2/single	Soft-IBM	$75.00
740-32P	1/single	32	$39.95
740/2-32P	2/single	32	$75.00
741-0	1/double	Soft	$59.00
		5"	
744-OK	1/single	Soft-(TRS-80)	$51.00*
744-10K	1/single	Soft/10	$51.00*
744-16K	1/single	Soft/16	$51.00*

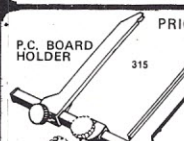
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14 & 16 PIN GOLD 3 LEVEL WIRE WRAP SOCKES*

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315—S same as 315 but with 14" bar to accomodate "S100" boards. PRICE. $19.98

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2114-3L 1Kx4 300 ns Low Power	8/$50.00
5257-3L 4Kx1 300ns Low Power	8/$50.00
2708 8K 450ns EPROM	8/65.00 $9.00
2716 16K 5 Volt Only EPROM	$40.00

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The ROAD RUNNER ADMM™ Features

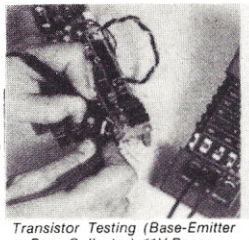
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ONLY $139.00 WES-6100

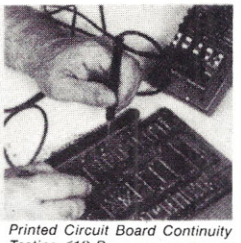
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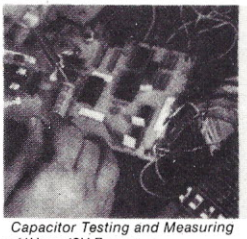
AUDIO RESPONSE IS A BIG TIME SAVER IN SERVICE APPLICATIONS



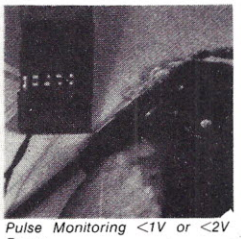
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Pulse Monitoring <1V or <2V Range

Specifications [From 18°C to 28°C]

DC VOLTAGE

Range	Resolution	Accuracy
100mV	100uV	
1V	1mV	
10V	10mV	0.5% reading ±1 digit
100V	100mV	
1000V	1V	

Overrange: 100% on all ranges except 1000V
Input Impedance: 10MΩ
Overload Protection: 1000V DC/750VAC
N.M.R.R.: 35dB min., line operation
C.M.R.R.: 80dB min., line operation

AC VOLTAGE (Average Sensing, RMS Calibrated.)

Range	Resolution	Accuracy 50Hz-60Hz	45Hz-400Hz	45Hz-1KHz
100mV	100uV	0.75% rdg ±3d		1% rdg ±3d
1V	1mV	0.75% rdg ±3d	1% rdg ±3d	
10V	10mV	0.75% rdg ±3d		1% rdg ±3d
100V	100mV	0.75% rdg ±3d		1% rdg ±3d
750V	1V	0.75% rdg ±3d	1% rdg ±3d	

Overrange: 100% on all ranges except 750V
Input Impedance: 10MΩ shunted by <100 pF
Overload Protection: 1000V DC/750VAC on all ranges except 100 mV range (300VAC for 15 sec)

AUDIO RESPONSE FUNCTION

Range	Accuracy
<1V	±0.01V Typ
<2V	±0.05V Typ
<1Ω	±0.2Ω Typ
<10Ω	±1Ω Typ
<100Ω	±10Ω Typ

Max. Test Current; 1mA Typ
Open Circuit Voltage: 2.8V Typ (source impedance 2.8kΩ typ)
Overload Protection: 300VAC/DC
Max. Continuous Operating Voltage: 20VAC/DC
Hysteresis: 3mV max. on voltage ranges
3Ω max. on resistance ranges.
Audio Indication: 2500Hz/3000Hz square wave with an approximate 2.5Hz/3Hz beat signal

RESISTANCE

Range	Resolution	Accuracy	Full Scale Voltage	Max. Text Current
100Ω	0.1Ω	0.5% reading ±3 digits	<150mV	750μA
1KΩ	1Ω		<80mV	55μA
10KΩ	10Ω	0.5% reading	<190mV	25μA
100KΩ	100Ω	±1 digit	<210mV	3μA
1000KΩ	1KΩ		<210mV	0.3μA
10MΩ	10KΩ	2.5% reading ±1 digit	<210mV	0.03μA

Overrange: 100% on all ranges
Overload Protection: 300VAC/DC
Open Circuit Voltage: 0.3V (except 100Ω range 2.2V)

DC CURRENT

Range	Resolution	Accuracy	Burden Voltage
1mA	1μA		0.5V DC max.
10mA	10μA	1% reading	0.5V DC max.
100mA	100μA	±1 digit	0.5V DC max.
1000mA	1mA		1V DC max.

Overrange: 100% on all ranges
Overload Protection: 2A, 250V fused, diode clamped

AC CURRENT (Average Sensing, RMS Calibrated.)

Range	Resolution	Accuracy 45Hz-100Hz	45Hz-400Hz	45Hz-1KHz
1mA	1μA	1.5% reading ±3 digits		
10mA	10μA		1.5% reading ±3 digits	
100mA	100μA			1.5% reading
1000mA	1mA			±3 digits

Overrange: 100% on all ranges
Overload Protection: 2A, 250V, fused, diode clamped
Burden Voltage: 0.5VAC max except 1000mA range, 1VAC max.

GENERAL

Display: 3½ digits reflective LCD 0.5" high
Polarity: Automatic
Reading Rate: 2.5 readings per sec.
Temperature: 0-50°C (operating) -20°C +60°C (storage)
Humidity: 0-85% RH (operating)
Temperature Coefficient: (0°C-18°C, 28°C-50°C) 0.1 x applicable accuracy/°C
Power: Single 9V battery NEDA 1604
Battery Life: Up to 200 hrs. with alkaline battery – "Lo Bat" displayed during the last 10% of useful battery life
Physical Characteristics: Weight: 1 lb. (0.45 Kg.)
Dimensions: 7.5 in. x 3.4 in. x 1.9 in. (190 mm x 86 mm x 49 mm)

P21

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16K-Keyboard N	$995
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B—large keyboard (graphics not on keys)
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The ADM-3A is industry's favorite dumb terminal for some very smart reasons:

- 12 in. diagonal screen
- Full or half duplex operation at 11 selectable data rates
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A self-contained module and program cassette enables your PET to function as a 300 baud terminal. Supports Upper/Lower case, Rubout, Escape & all control functions. Output is TTL.

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Zenith's first color video display designed specifically for computers.

This 13-inch monitor is Zenith's first color video display designed specifically for computers. Features include automatic color level, color processing and degaussing circuits.

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apple II plus

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The new Apple II with Applesoft BASIC built-in! Eliminates the need for a $200 Firmware Card and includes new Autostart ROM for easy operation. This combined with the FREE accessories from NCE could save you up to $400 on a 48K Apple II system!

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The Graphics Printer for Apple II

Now you can print illustrations, block letters, charts, graphs, and more—all under software control. And with the expanded buffer, the Paper Tiger can hold the text from an entire 24-line-by-80-column CRT screen.

$1194.00

NEW **from Heath Data Systems**

The All-In-One Computer

Dual Z-80 Processors • Built-in 102K Floppy Disk • 16K to 48K RAM • 25 x 80 Character Display • Upper/Lower Case and Line Graphics • 80 Character Keyboard with Keypad • 8 User-definable Keys • Two BASIC's and Auto-Scribe Word Processing available • Can support CP/M

Heath's third generation of computers is a compact, hi-style desktop unit which includes a complete terminal, a computer and a disk All-In-One! System includes Bootstrap in ROM, other programs available separately. HDOS operating system includes Heath's BASIC, an assembler and text editor along with important disk utilities. Microsoft language requires HDOS.

WH89 with 16K RAM	$2,295
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- Parallel interface
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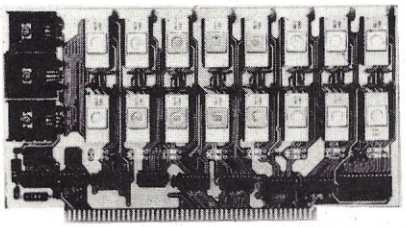
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USES 2708's!

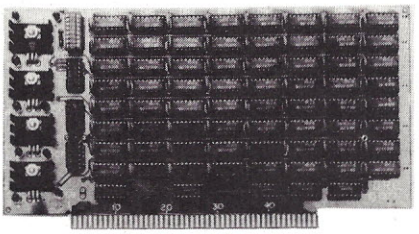
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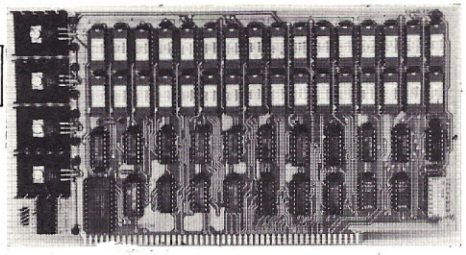
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16K STATIC RAM KIT-S 100 BUSS

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FOR 4MHZ ADD $25



KIT FEATURES:
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3. Uses 2114 (450NS) 4K Static Rams.
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6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

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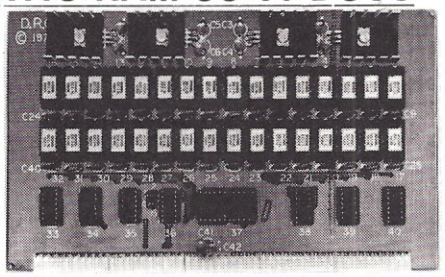
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FOR SWTPC 6800 BUSS!

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4. Double sided PC Board Solder mask and silk screened layout. Gold fingers.
5. All Parts and Sockets included
6. Low Power: Under 1.5 Amps Typical

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By MOSTEK, or ZILOG. The most detailed explanation ever on the working of the Z-80 CPU CHIPS. At least one full page on each of the 158 Z-80 instructions. A **must** reference manual for any user of the Z-80. 300 pages. **$12.95**

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4K STATIC RAM'S. MAJOR BRAND, NEW PARTS.
These are the most sought after 2114's, LOW POWER and 250NS FAST.
SPECIAL SALE: $7.50 ea. or 8 For $55

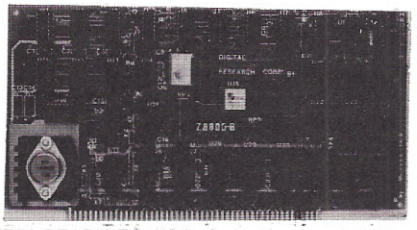
S-100 Z80 CPU CARD

Perfect for OEM's

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WIRED! NOT A KIT!

4 MHZ



ASSEMBLED AND TESTED! READY TO USE! Over 3 years of design efforts were required to produce a **TRUE** S-100 Z80 CPU at a genuinely bargain price! **BRAND NEW!**

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★ 2 or 4 MHZ Operation. ★ Generates MWRITE, so no front panel required.
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★ Top Quality PCB. Silk Screened, Solder Masked, Gold Plated Contact Fingers.

NEW! G.I. COMPUTER SOUND CHIP

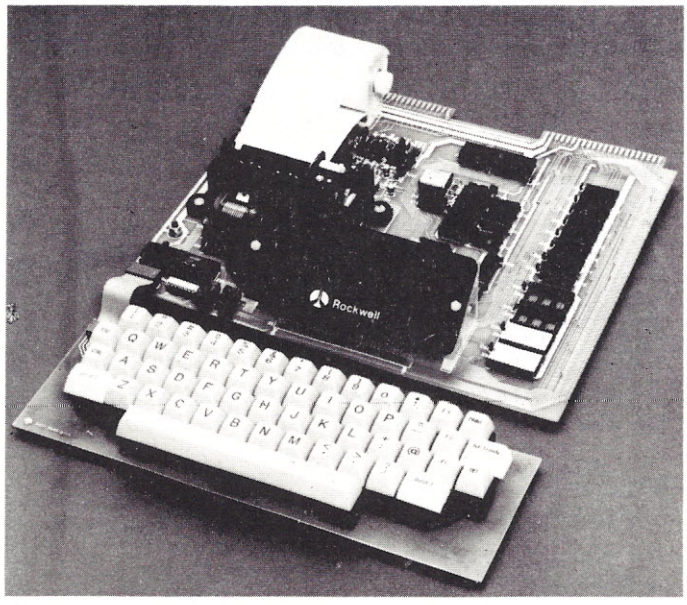
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AIM 65 BY ROCKWELL INTERNATIONAL



AIM 65 is fully assembled, tested and warranted. With the addition of a low cost, readily available power supply, it's ready to start working for you.

AIM 65 features on-board thermal printer and alphanumeric display, and a terminal-style keyboard. It has an addressing capability up to 65K bytes, and comes with a user-dedicated 1K or 4K RAM. Two installed 4K ROMS hold a powerful Advanced Interface Monitor program, and three spare sockets are included to expand on-board ROM or PROM up to 20K bytes.

An Application Connector provides for attaching a TTY and one or two audio cassette recorders, and gives external access to the user-dedicated general purpose I/O lines.

Also included as standard are a comprehensive AIM 65 User's Manual, a handy pocket reference card, an R6500 Hardware Manual, an R6500 Programming Manual and an AIM 65 schematic.

AIM 65 is packaged on two compact modules. The circuit module is 12 inches wide and 10 inches long, the keyboard module is 12 inches wide and 4 inches long. They are connected by a detachable cable.

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Most desired feature on low-cost microcomputer systems . . .
- Wide 20-column printout
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- Fast 120 lines per minute
- Quite thermal operation
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Provides compatibility with system terminals . . .
- Standard 54 key, terminal-style layout
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- 10 numeric characters
- 22 special characters
- 9 control functions
- 3 user-defined functions

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Provides legible and lengthy display . . .
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- High contrast monolithic characters
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Reliable, high performance NMOS technology . . .
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- R6532 RAM-Input/Output-Timer (RIOT) combination device. Multipurpose circuit for AIM 65 Monitor functions.
- Two R6522 Versatile Interface Adapter (VIA) devices, which support AIM 65 and user functions. Each VIA has two parallel and one serial 8-bit, bidirectional I/O ports, two 2-bit peripheral handshake control lines and two fully-programmable 16-bit interval timer/event counters.

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- 44-Pin Application Connector for peripheral add-ons
- 44-Pin Expansion Connector has full system bus
- Both connectors are KIM-1 compatible

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Standard interface to low-cost peripherals . . .
- 20 ma. current loop TTY interface
- Interface for two audio cassette recorders
- Two audio cassette formats: ASCII KIM-1 compatible and binary, blocked file assembler compatible

ROM RESIDENT ADVANCED INTERACTIVE MONITOR
Advanced features found only on larger systems . . .
- Monitor-generated prompts
- Single keystroke commands
- Address independent data entry
- Debug aids
- Error messages
- Option and user interface linkage

ADVANCED INTERACTIVE MONITOR COMMANDS
- Major Function Entry
- Instruction Entry and Disassembly
- Display/Alter Registers and Memory
- Manipulate Breakpoints
- Control Instruction/Trace
- Control Peripheral Devices
- Call User-Defined Functions
- Comprehensive Text Editor

LOW COST PLUG-IN ROM OPTIONS
- 4K Assembler—symbolic, two-pass , A65-010 $79.00
- 8K BASIC Interpreter A65-020 $99.00

POWER SUPPLY SPECIFICATIONS
- +5 VDC ± 5% regulated @ 2.0 amps (max)
- +24 VDC ±15% unregulated @ 2.5 amps (peak) 0.5 amps average

PRICE: $369.00 (1K RAM) $419.00 (4K RAM)

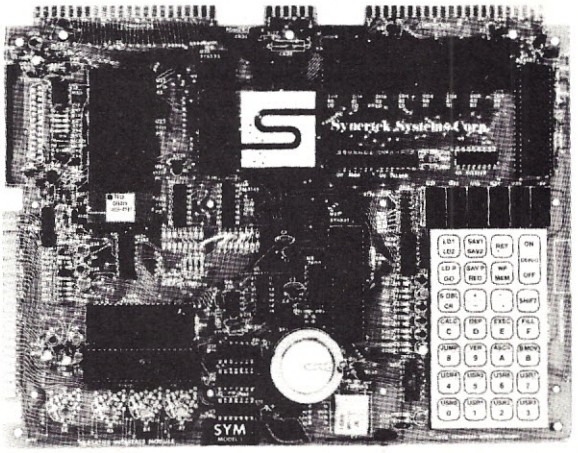
Plus $4.00 UPS (shipped in U.S. must give ***street*** address), $10 parcel post to APO's, FPO's, Alaska, Hawaii, Canada, $25 air mail to all other countries
AIM 65 USER MANUAL $5.00 plus $1.50 shipping & handling.
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SYM-1, 6502-BASED MICROCOMPUTER

- FULLY-ASSEMBLED AND COMPLETELY INTEGRATED SYSTEM that's ready-to-use
- ALL LSI IC'S ARE IN SOCKETS
- 28 DOUBLE-FUNCTION KEYPAD INCLUDING UP TO 24 "SPECIAL" FUNCTIONS
- EASY-TO-VIEW 6-DIGIT HEX LED DISPLAY
- KIM-1* HARDWARE COMPATIBILITY
  The powerful 6502 8-Bit MICROPROCESSOR whose advanced architectural features have made it one of the largest selling "micros" on the market today.
- THREE ON-BOARD PROGRAMMABLE INTERVAL TIMERS available to the user, expandable to five on-board.
- 4K BYTE ROM RESIDENT MONITOR and Operating Programs.
- Single 5 Volt power supply is all that is required.
- 1K BYTES OF 2114 STATIC RAM onboard with sockets provided for immediate expansion to 4K bytes onboard, with total memory expansion to 65, 536 bytes.
- USER PROM/ROM: The system is equipped with 3 PROM/ROM expansion sockets for 2316/2332 ROMs or 2716 EPROMs
- ENHANCED SOFTWARE with simplified user interface
- STANDARD INTERFACES INCLUDE:
  —Audio Cassette Recorder Interface with Remote Control (Two modes: 135 Baud KIM-1* compatible, Hi-Speed 1500 Baud)
  —Full duplex 20mA Teletype Interface
  —System Expansion Bus Interface
  —TV Controller Board Interface
  —CRT Compatible Interface (RS-232)
- APPLICATION PORT: 15 Bi-directional TTL Lines for user applications with expansion capability for added lines
- EXPANSION PORT FOR ADD-ON MODULES (51 I/O Lines included in the basic system)
- SEPARATE POWER SUPPLY connector for easy disconnect of the d-c power
- AUDIBLE RESPONSE KEYPAD



Synertek has enhanced KIM-1* software as well as the hardware. The software has simplified the user interface. The basic SYM-1 system is programmed in machine language. Monitor status is easily accessible, and the monitor gives the keypad user the same full functional capability of the TTY user. The SYM-1 has everything the KIM-1* has to offer, plus so much more that we cannot begin to tell you here. So, if you want to know more, the SYM-1 User Manual is available, separately

SYM-1 Complete w/manuals **$229.00**
SYM-1 User Manual Only **$7.00**
SYM-1 Expansion **$60.00**

Expansion includes 3K of 2114 RAM chips and 1-6522 I/O chip.

SYM-1 Manuals: The well organized documentation package is complete and easy-to-understand.

SYM-1 CAN GROW AS YOU GROW. It's the system to BUILD-ON. Expansion features that are available:

BAS-1 8K Basic ROM (Microsoft Basic) **$89.00**
KTM-2 (Complete terminal less monitor) **$319.00**

QUALITY EXPANSION BOARDS DESIGNED SPECIFICALLY FOR KIM-1, SYM-1 & AIM 65

These boards are set up for use with a regulated power supply such as the one below, but, provisions have been made so that you can add onboard regulators for use with an unregulated power supply. But, because of unreliability, we do not recommend the use of onboard regulators. All I.C.'s are socketed for ease of maintenance. *All boards carry full 90-day warranty.*

All products that we manufacture are designed to meet or exceed industrial standards. All components are first qualtiy and meet full manufacturer's specifications. All this and an extended burn-in is done to reduce the normal percentage of field failures by up to 75%. To you, this means the chance of inconvenience and lost time due to a failure is very rare; but, if it should happen, we guarantee a turn-around time of less than forty-eight hours for repair.

Our money back guarantee: If, for any reason you wish to return any board that you have purchased directly from us within ten (10) days after receipt, complete, in original condition, and in original shipping carton; we will give you a complete credit or refund less a $10.00 restocking charge per board.

VAK-1 8-SLOT MOTHERBOARD

This motherboard uses the KIM-4* bus structure. It provides eight (8) expansion board sockets with rigid card cage. Separate jacks for audio cassette, TTY and power supply are provided. Fully buffered bus.

VAK-1 Motherboard **$129.00**

VAK-2/4 16K STATIC RAM BOARD

This board using 2114 RAMs is configured in two (2) separately addressable 8K blocks with individual write-protect switches.

VAK-2 16K RAM Board with only 8K of RAM (½ populated)
VAK-3 Complete set of chips to expand above board to 16K **$125.00**
VAK-4 Fully populated 16K RAM **$325.00**

VAK-5 2708 EPROM PROGRAMMER

This board requires a +5 VDC and ±12 VDC, but has a DC to DC multiplyer so there is no need for an additional power supply. All software is resident in on-board ROM, and has a zero-insertion socket.

VAK-5 2708 EPROM Programmer **$249.00**

VAK-6 EPROM BOARD

This board will hold 8K of 2708 or 2758, or 16K of 2716 or 2516 EPROMs. *EPROMs not included.*

VAK-6 EPROM Board **$119.00**

VAK-7 COMPLETE FLOPPY-DISK SYSTEM (May '79) $1299.00
Use reader service card for details

VAK-8 PROTYPING BOARD

This board allows you to create your own interfaces to plug into the motherboard. Etched circuitry is provided for regulators, address and data bus drivers; with a large area for either wire-wrapped or soldered IC circuitry.

VAK-8 Protyping Board **$39.00**

POWER SUPPLIES

ALL POWER SUPPLIES are totally enclosed with grounded enclosures for safety, AC power cord, and carry a full 2-year warranty.

FULL SYSTEM POWER SUPPLY

This power supply will handle a microcomputer and up to 65K of our VAK-4 RAM. ADDITIONAL FEATURES ARE: Over voltage Protection on 5 volts, fused, AC on/off switch. Equivalent to units selling for $225.00 or more.

Provides +5 VDC @ 10 Amps & ±12 VDC @ 1 Amp
VAK-EPS Power Supply **$119.00**

KIM-1* Custom P.S. provides 5 VDC @ 1.2 Amps and +12 VDC @ .1 Amps
KCP-1 Power Supply **$39.00**

SYM-1 Custom P.S. provides 5 VDC @ 1.4 Amps
VCP-1 Power Supply **$39.00**

*KIM is a product of MOS Technology

Add $2.50 for shipping & handling for all except AIM 65.

VAK-EPS/AIM—same as VAK-EPS but w/additional 24 volt unregulated (specifically for AIM 65) **$149.00**

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Whether it's memory, motherboards, I/O boards, enclosures, or any of our family of products, **CompuPro™** delivers what you want at prices you can afford.

Looking for memory? Our boards are fully static, low power, run at 4 or 5 MHz, support a number of popular busses, include a 1 year limited warranty, and generally come in 3 configurations to suit your exact needs. For lowest cost, choose an **"unkit"** with sockets and bypass caps pre-soldered in place for easy assembly. When you can't wait to get going, order one of our assembled versions. For critical systems, specify boards qualified under our **Certified System Component** (CSC) high reliability program. These boards are extensively tested, burned in for at least 200 hours, and are immediately replaced in event of failure within 1 year of invoice date.

Looking for other peripherals? We mix leading edge technology, design savvy, and volume buying to deliver the right product at the right price. See our list below for pricing.

Memory name	Buss & Notes	Unkit	Assm	CSC
8K Econoram* IIA	S-100	**$149**	**$179**	**$239**
16K Econoram IV	S-100	**$289**	**$339**	**$429**
16K Econoram VIIA-16	S-100	**$299**	**$349**	**$439**
24K Econoram VIIA-24	S-100	**$419**	**$499**	**$605**
16K Econoram IX-16	Dig Grp	**$319**	**$379**	n/a
32K Econoram IX-32	Dig Grp	**$559**	**$639**	n/a
32K Econoram X	S-100	**$549**	**$669**	**$789**
32K Econoram XI	SBC/BLC	n/a	n/a	**$1050**
16K Econoram XIIIA-16	S-100 (1)	**$349**	**$419**	**$519**
24K Econoram XIIIA-24	S-100 (1)	**$469**	**$539**	**$649**
32K Econoram XIIIA-32	S-100 (1)	**$579**	**$699**	**$849**
16K Econoram XIV	S-100 (2)	**$299**	**$359**	**$459**
16K Econoram XV-16	H8 (3)	**$329**	**$395**	n/a
32K Econoram XV-32	H8 (3)	**$599**	**$729**	n/a

***Econoram** is a trademark of **Godbout Electronics**

(1) Compatible with all bank select systems (Cromemco, Alpha Micro, etc.); addressable on 4K boundaries.
(2) Extended addressing (24 address lines). Single block addressable on 4K boundaries.
(3) Bank select option for implementing memory systems greater than 64K.

NEW YEAR SPECIAL

250 ns 16K dynamic RAMs

8/$64!

Perfect for memory expansion in a number of machines (**TRS-80**** Model I and Model II, **Exidy Sorcerer**, **Heath H89**, **Apple**, etc.), and you can't beat our price: 8 high speed chips for $64! Add $3 if you'd like 2 dip shunts plus TRS-80** programming instructions to expand memory. These are 250 ns (4 MHz), dynamic RAMs... but quantities are limited, so hurry is you want to take advantage of this super deal.

**TRS-80 is a trademark of the Tandy Corporation.

PASCAL/M™ + MEMORY SPECIAL

PASCAL can give a microcomputer with CP/M more power than many minis. For a limited time only, you can buy an assembled Econoram X, plus our totally standard Wirth PASCAL/M™ 8" diskette, for $799 (regular combined price, $999). Includes manual, plus Wirth's definitive book on PASCAL; specify Z-80 or 8080/8085 version. Diskette is also available separately for $350.

2708 EROM BOARD $85 unkit

4 independently addressable 4K blocks, with dip-switch selectable jump start built right into the board. Includes all support chips and manual, but does not include EROMs.

THESE PRODUCTS ARE GENERALLY AVAILABLE FROM YOUR LOCAL COMPUTER STORE.

ACTIVE TERMINATOR BOARD $34.50 kit

Plugs into any S-100 motherboard (although ours don't need it) to reduce ringing, crosstalk, noise, and other buss-related problems.

THE GODBOUT COMPUTER BOX

$259 desktop, $299 rack mount (introductory price)

The ideal home for your computer. With fan, dual AC outlets and fuseholder, power switch, heavy-duty line filter, black anodized front panel (with textured vinyl painted cover for desk top version); pre-drilled base accepts our high-performance motherboards or similar types by Vector, California Digital, and others. Rack mount version includes slides for easy pull-out from rack. This functional, versatile, and handsome enclosure does justice to the finest computer systems.

HIGH-PERFORMANCE S-100 MOTHERBOARDS

6 slot: $ **89** unkit, **$129** assm **12 slot:** **$129** unkit, **$169** assm
19 slot: **$174** unkit, **$214** assm

Unkits have edge connectors and termination resistors pre-soldered in place for easy assembly. These boards exceed the latest S-100 specs and will work with 5 to 10 MHz CPUs. Includes true active termination, grounded Farady shield between all buss signal lines, and edge connectors for all slots.

S-100 MEMORY MANAGER BOARD

$59 unkit
$85 assm
$100 CSC

Add bank select and extended addressing to older S-100 machines (Altair, IMSAI, Sol, and others). Use with our new extended addressing boards, or retrofit our high density **Econorams** for use with the **Memory Manager** to get added memory space for your computer.

MULLEN S-100 EXTENDER BOARD $49 kit

Includes logic probe and general purpose breadboard section. Ideal for troubleshooting and analysis.

3P PLUS S "Interfacer II" S-100 I/O BOARD

$199 unkit
$249 assm
$324 CSC

Incorporates 1 channel of serial I/O (RS-232 with full handshake), along with 3 full duplex parallel ports plus a separate status port. The parallel section uses Tri-State (tm National Semiconductor) octal latches for latched data, input and output with 24 mA drive current, attention/enable/strobe bits for each parallel port (with selectable polarity), interrupts for each input port, and separate connectors with power for each channel.

2S "Interfacer I" S-100 I/O BOARD

$199 unkit
$249 assm
$324 CSC

Dual RS-232 ports with full handshake; use EIA232C line drivers and receivers (1488, 1489), or current loop (20 mA), or TTL signals on both ports. On-board crystal timebase with independently selectable Baud rates for each port (up to 19.2 KBaud). Hardware UARTs don't tie up the CPU.

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Start Computing For Just $129.95 With An 8085-Based Professional Computer Kit—

Explorer/85

100% compatible with all 8080A and 8085 software & development tools!

No matter what your future computing plans may be, Level "A"—at $129.95—is your starting point.

Starting at just $129.95 for a Level "A" operating system, you can now build the exact computer you want. Explorer/85 can be your beginner's system, OEM controller, or IBM-formatted 8" disk small business system...yet you're never forced to spend a penny for a component or feature you don't want and you can expand in small, affordable steps!

Now, for just $129.95, you can own the first level of a fully expandable computer with professional capabilities—a computer which features the advanced Intel 8085 cpu, *thereby giving you immediate access to all software and development tools that exist for both the 8085 and its 8080A predecessor (they are 100% software compatible)*—a computer which features onboard S-100 bus expansion—plus instant conversion to mass storage disk memory with either 5-1/4" diskettes or standard IBM-formatted 8" disks.

For just $129.95 (plus the cost of a power supply, keyboard/terminal and RF modulator, if you don't have them already), Explorer/85 lets you begin *computing* on a significant level... *applying* the principles discussed in leading computer magazines...*developing* "state of the art" computer solutions for both the industrial and leisure environment.

Level "A" Specifications

Explorer/85's Level "A" system features the advanced Intel 8085 cpu, an 8355 ROM with 2k deluxe monitor/operating system, and an 8155 ROM-I/O—all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, *plus* generous prototyping space.

(Level "A" makes a perfect OEM controller for industrial applications and is available in a special Hex Version which can be programmed using the Netronics Hex Keypad/Display.)

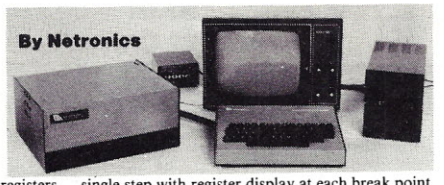


Level "A" at $129.95 is a complete operating system, perfect for beginners, hobbiests, or industrial controller use.

PC Board: glass epoxy, plated through holes with solder mask • **I/O:** provisions for 25-pin (DB25) connector for terminal serial I/O, which can also support a paper tape reader ...provision for 24-pin DIP socket for hex keyboard/display...cassette tape recorder input...cassette tape recorder output...cassette tape control output...speaker output... LED output indicator on SOD (serial output) line...printer interface (less drivers)...total of four 8-bit plus one 6-bit I/O ports • **Crystal Frequency:** 6.144 MHz • **Control Switches:** reset and user (RST 7.5) interrupt...additional provisions for RST 5.5, 6.5 and TRAP interrupts onboard • **Counter/Timer:** programmable, 14-bit binary • **System RAM:** 256 bytes located at F8ØØ, ideal for smaller systems and for use as an isolated stack area in expanded systems...RAM expandable to 64k via S-100 bus or 4K on motherboard.

System Monitor (Terminal Version): 2k bytes of deluxe system monitor ROM located at FØØØ leaving ØØØØ free for user RAM/ROM. Features include tape load with labeling ...tape dump with labeling...examine/change contents of memory ...insert data...warm start...examine and change all registers...single step with register display at each break point, a debugging/training feature...go to execution address... move blocks of memory from one location to another...fill blocks of memory with a constant...display blocks of memory ...automatic baud rate selection...variable display line length control (1-255 characters/line)...channelized I/O monitor routine with 8-bit parallel output for high speed printer... serial console in and console out channel so that monitor can communicate with I/O ports.

System Monitor (Hex Version): Tape load with labeling... tape dump with labeling...examine/change contents of memory...insert data...warm start...examine and change all registers...single step with register display at each break point ...go to execution address. Level "A" in the *Hex Version* makes a perfect controller for industrial applications and can be programmed using the Netronics Hex Keypad/Display.





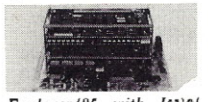
Hex Keypad/Display.

Hex Keypad/Display Specifications

Calculator type keypad with 24 system defined and 16 user defined keys. 6 digit calculator type display which displays full address plus data as well as register and status information.

Level "B" Specifications

Level"B" provides the S-100 signals plus buffers/drivers to support up to six S-100 bus boards and includes: address decoding for onboard 4k RAM expansion select-able in 4k blocks...address decoding for onboard 8k EPROM expansion selectable in 8k blocks...address and data bus drivers for onboard expansion...wait state generator (jumper selectable), to allow the use of slower memories...two separate 5 volt regulators.



Explorer/85 with Level "C" card cage.

Level "C" Specifications

Level "C" expands Explorer's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and cards are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card gold plated S-100 extension PC board which plugs into the motherboard. Just add required number of S-100 connectors

Level "D" Specifications

Level "D" provides 4k or RAM, power supply regulation, filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the original 256 bytes located in the 8155A). The static RAM can be located anywhere from ØØØØ to EFFF in 4k blocks.

Level "E" Specifications

Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for soon to be available RAM IC's (allowing for up to 12k of onboard RAM).

Order A Coordinated Explorer/85 Applications Pak!

Experimenter's Pak (SAVE $12.50)—Buy Level "A" and Hex Keypad/Display for **$199.90** and get FREE Intel 8085 user's manual plus FREE postage & handling!

Student Pak (SAVE $24.45)—Buy Level "A," ASCII Keyboard/Computer Terminal, and Power Supply for **$319.85** and get FREE RF Modulator plus FREE Intel 8085 user's manual plus FREE postage & handling!

Engineering Pak (SAVE $41.00)—Buy Levels "A," "B," "C," "D," and "E" with Power Supply, ASCII Keyboard/Computer Terminal, and six S-100 Bus Connectors for **$514.75** and get 10 FREE computer grade cassette tapes plus FREE 8085 user's manual plus FREE postage & handling!

Business Pak (SAVE $89.95)—Buy Explorer/85 Levels "A," "B," and "C" (with cabinet), Power Supply, ASCII Keyboard/Computer Terminal (with cabinet), 16k RAM, 12" Video Monitor, North Star 5-1/4" Disk Drive (includes North Star BASIC) with power supply and cabinet, all for just **$1599.40** and get 10 FREE 5-1/4" minidiskettes ($49.95 value) plus FREE 8085 user's manual plus FREE postage & handling!

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Please send the items checked below—

- ☐ **Explorer/85 Level "A" Kit** (ASCII Version), **$129.95** plus $3 p&h.
- ☐ **Explorer/85 Level "A" Kit** (Hex Version), **$129.95** plus $3 p&h.
- ☐ **8k Microsoft BASIC** on cassette tape, **$64.95** postpaid.
- ☐ **8k Microsoft BASIC in ROM Kit** (requires Levels "B," "D," and "E"), **$99.95** plus $2 p&h.
- ☐ **Level "B" (S-100) Kit, $49.95** plus $2 p&h.
- ☐ **Level "C" (S-100 6-card expander) Kit, $39.95** plus $2 p&h.
- ☐ **Level "D" (4k RAM) Kit, $69.95** plus $2 p&h.
- ☐ **Level "E" (EPROM/ROM) Kit, $5.95** plus 50¢ p&h.
- ☐ **Deluxe Steel Cabinet** for Explorer/85, **$49.95** plus $3 p&h.
- ☐ **ASCII Keyboard/Computer Terminal Kit** (features a full 128 character set, upper & lower case, full cursor control, 75 ohm video output convertible to baudot output, selectable baud rate, RS232-C or 20 ma. I/O, 32 or 64 character by 16 line formats, and can be used with either a CRT monitor or a TV set (if you have an RF modulator), **$149.95** plus $2.50 p&h.
- ☐ **Hex Keypad/Display Kit, $69.95** plus $2 p&h.
- ☐ **Deluxe Steel Cabinet** for ASCII Keyboard/Terminal, **$19.95** plus $2.50 p&h.
- ☐ **Power Supply Kit** (±8V @ 5 amps) in deluxe steel cabinet, **$39.95** plus $2 p&h.
- ☐ **Gold Plated S-100 Bus Connectors, $4.85** each, postpaid.
- ☐ **RF Modulator Kit** (allows you to use your TV set as a monitor), **$8.95** postpaid.
- ☐ **16k RAM Kit** (S-100 Board expands to 64k), **$199.95** plus $2 p&h.
- ☐ **32k RAM Kit, $329.95** plus $2 p&h.
- ☐ **48K RAM Kit, $459.95** plus $2 p&h.
- ☐ **64k RAM Kit, $589.95** plus $2 p&h.
- ☐ **16k RAM Expansion Kit** (to expand any of the above up to 64k), **$139.95** plus $2 p&h each.
- ☐ **Intel 8085 cpu User's Manual, $7.50** postpaid.
- ☐ **Special Computer Grade Cassette Tapes, $1.90** each or **3 for $5,** postpaid.
- ☐ **12" Video Monitor** (10 MHz bandwidth), **$139.95** plus $5 p&h.
- ☐ **North Star Double Density Floppy Disk Kit** (One Drive) for Explorer/85 (includes 3 drive S-100 controller, DOS, and extended BASIC with personalized disk operating system—just plug it in and you're up and running!), **$699.95** plus $5 p&h.
- ☐ **Power Supply Kit** for North Star Disk Drive, **$39.95** plus $2 p&h.
- ☐ **Deluxe Case** for North Star Disk Drive, **$39.95** plus $2 p&h.
- ☐ **Experimenter's Pak** (see above), **$199.90** postpaid.
- ☐ **Student Pak** (see above), **$319.85** postpaid.
- ☐ **Engineering Pak** (see above), **$514.75** postpaid.
- ☐ **Business Pak** (see above), **$1599.40** postpaid.

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Signature _____ Exp. Date ____

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By Netronics

ASCII/BAUDOT, STAND ALONE

Computer Terminal

COMPLETE FOR ONLY . . . $149.95

The Netronics ASCII/BAUDOT Computer Terminal Kit is a microprocessor-controlled, stand alone keyboard/terminal requring no computer memory or software. It allows the use of either a 64 or 32 character by 16 line professional display format with selectable baud rate, RS232-C or 20 ma. output, full cursor control and 75 ohm composite video output.

The keyboard follows the standard typewriter configuration and generates the entire 128 character ASCII upper/lower case set with 96 printable characters. Features include onboard regulators, selectable parity, shift lock key, alpha lock jumper, a drive capability of one TTY load, and the ability to mate directly with almost any computer, including the new Explorer/85 and ELF products by Netronics.

The Computer Terminal requires no I/O mapping and includes 1k of memory, character generator, 2 key rollover, processor controlled cursor control, parallel ASCII/BAUDOT to serial conversion and serial to video processing—fully crystal controlled for superb accuracy. PC boards are the highest quality glass epoxy for the ultimate in reliability and long life.

VIDEO DISPLAY SPECIFICATIONS

The heart of the Netronics Computer Terminal is the microprocessor-controlled Netronics Video Display Board (VID) which allows the terminal to utilize either a parallel ASCII or BAUDOT signal source. The VID converts the parallel data to serial data which is then formatted to either RS232-C or 20 ma. current loop output, which can be connected to the serial I/O on your computer or other interface, i.e., Modem.

When connected to a computer, the computer must echo the character received. This data is received by the VID which processes the information, converting to data to video suitable to be displayed on a TV set (using an RF modulator) or on a video monitor. The VID generates the cursor, horizontal and vertical sync pulses and performs the housekeeping relative to which character and where it is to be displayed on the screen.

Video Output: *1.5 P/P into 75 ohm (EIA RS-170)* • **Baud Rate:** *110 and 300 ASCII* • **Outputs:** *RS232-C or 20 ma. current loop* • **ASCII Character Set:** *128 printable characters—*



BAUDOT Character Set: *A B C D E F G H I J K L M N O P Q R S T U V W X Y Z - ? : • 3 $ # ( ) . , 9 0 1 4 ! 5 7 ; 2 / 6 8* • **Cursor Modes:** *Home, Backspace, Horizontal Tab, Line Feed, Vertical Tab, Carriage Return. Two special cursor sequences are provided for absolute and relative X-Y cursor addressing* • **Cursor Control:** *Erase, End of Line, Erase of Screen, Form Feed, Delete* • **Monitor Operation:** *50 or 60Hz (jumper selectable.*

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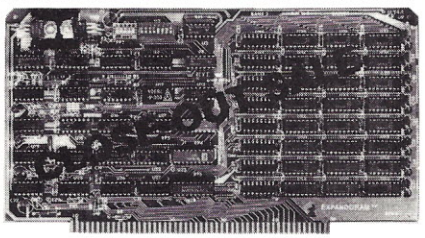
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✔ Reader Service index—page 241

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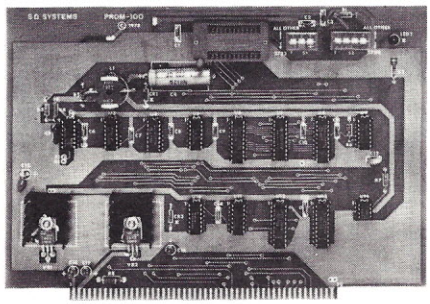
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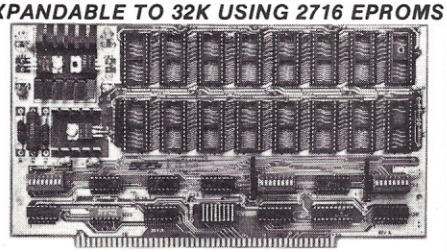
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Dip switch selects 2708, 2716, 2732, 2758, or 2516's
25 VDC programming pulse generated on board
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Support-software listing provided in manual
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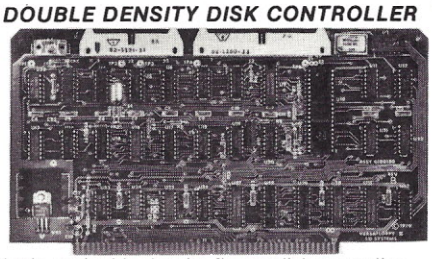
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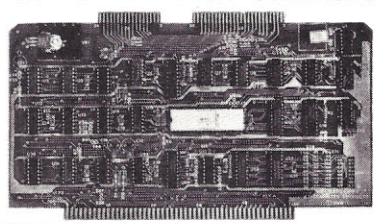
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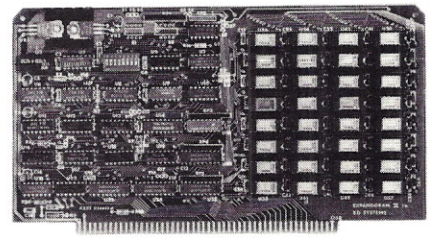
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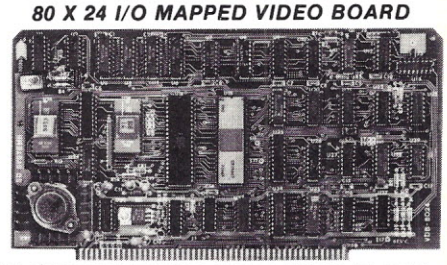
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Expandable memory from 16K to 256K
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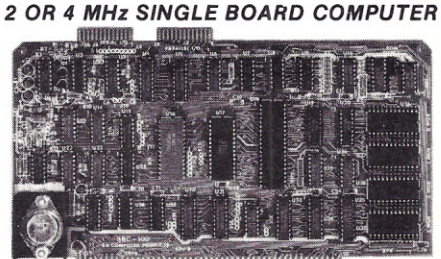
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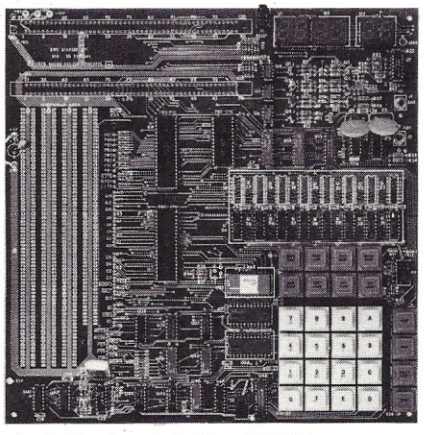
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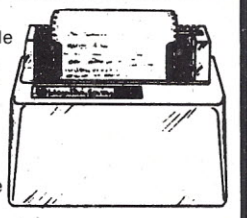
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Eight software selectable character sizes.
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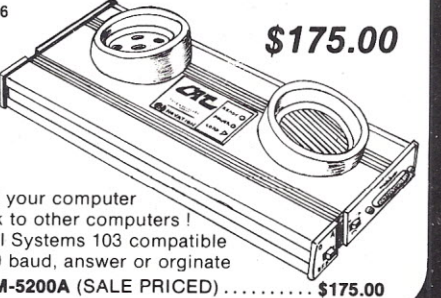
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Larger board measures 13½"x6" and has 75 to 100 sockets. **Reduced Price . . . $12.50 ea. 2/$23.00**

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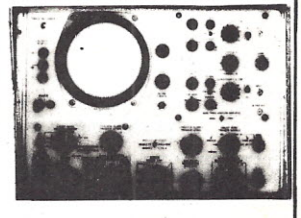
100 tracks per inch, total capacity of 50 megabits, w/Model 429 power supply, sector counter, 24 sectors, 1 fixed disc, 1 removable disc, average access time 38 ms, PPM: 2400, dimensions: 10 5/16" high, fits in standard rack, equipped with full extension slides, excellent used condition. Shipped freight collect.



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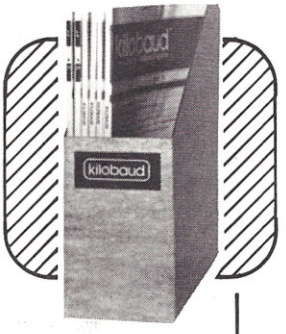
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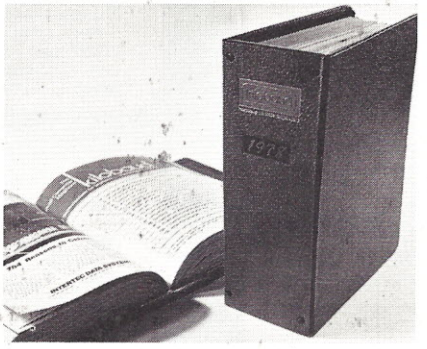
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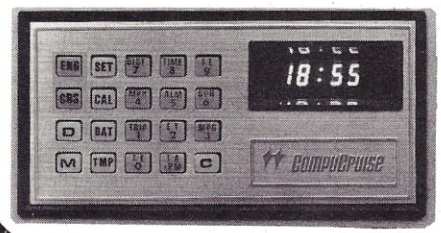
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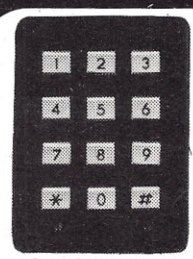
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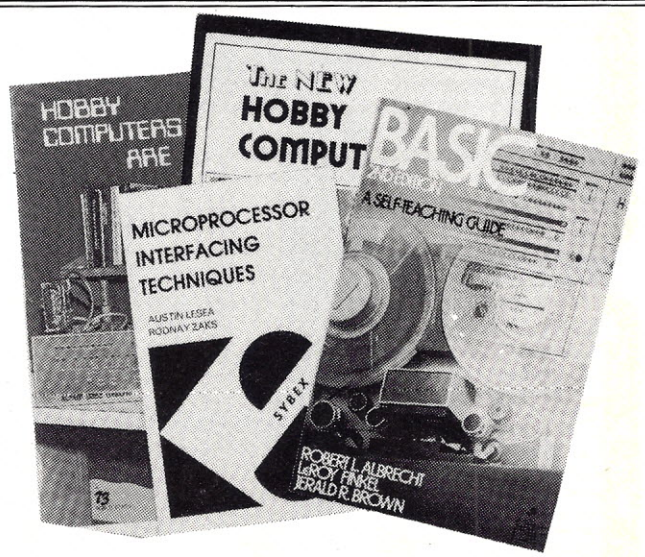
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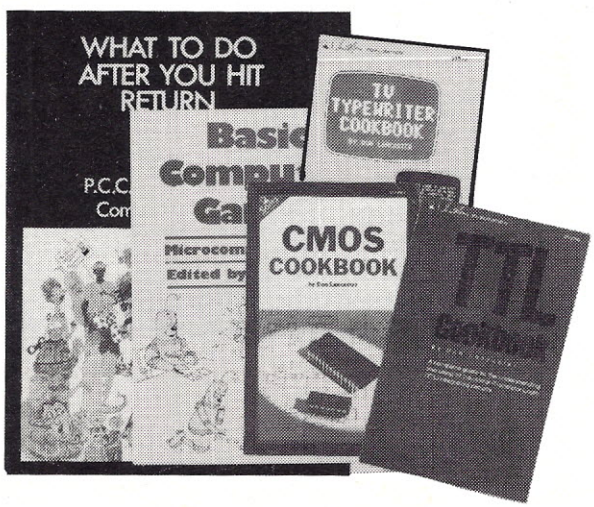
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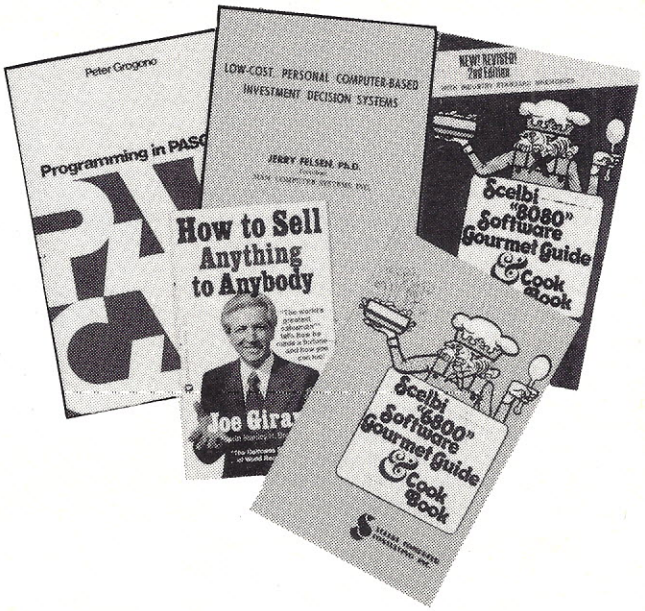
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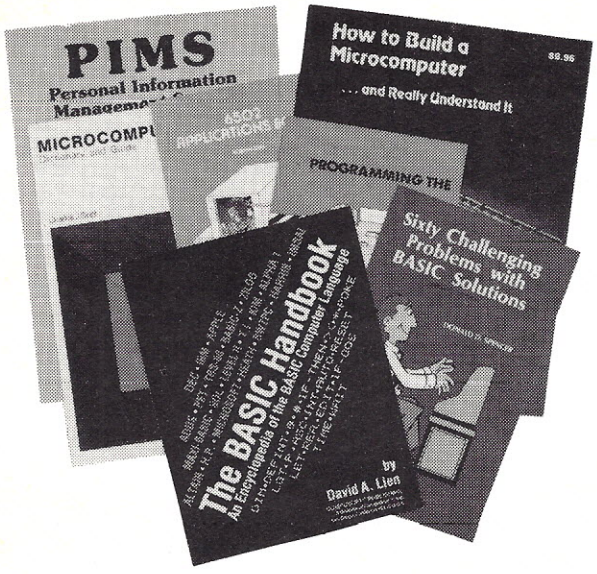
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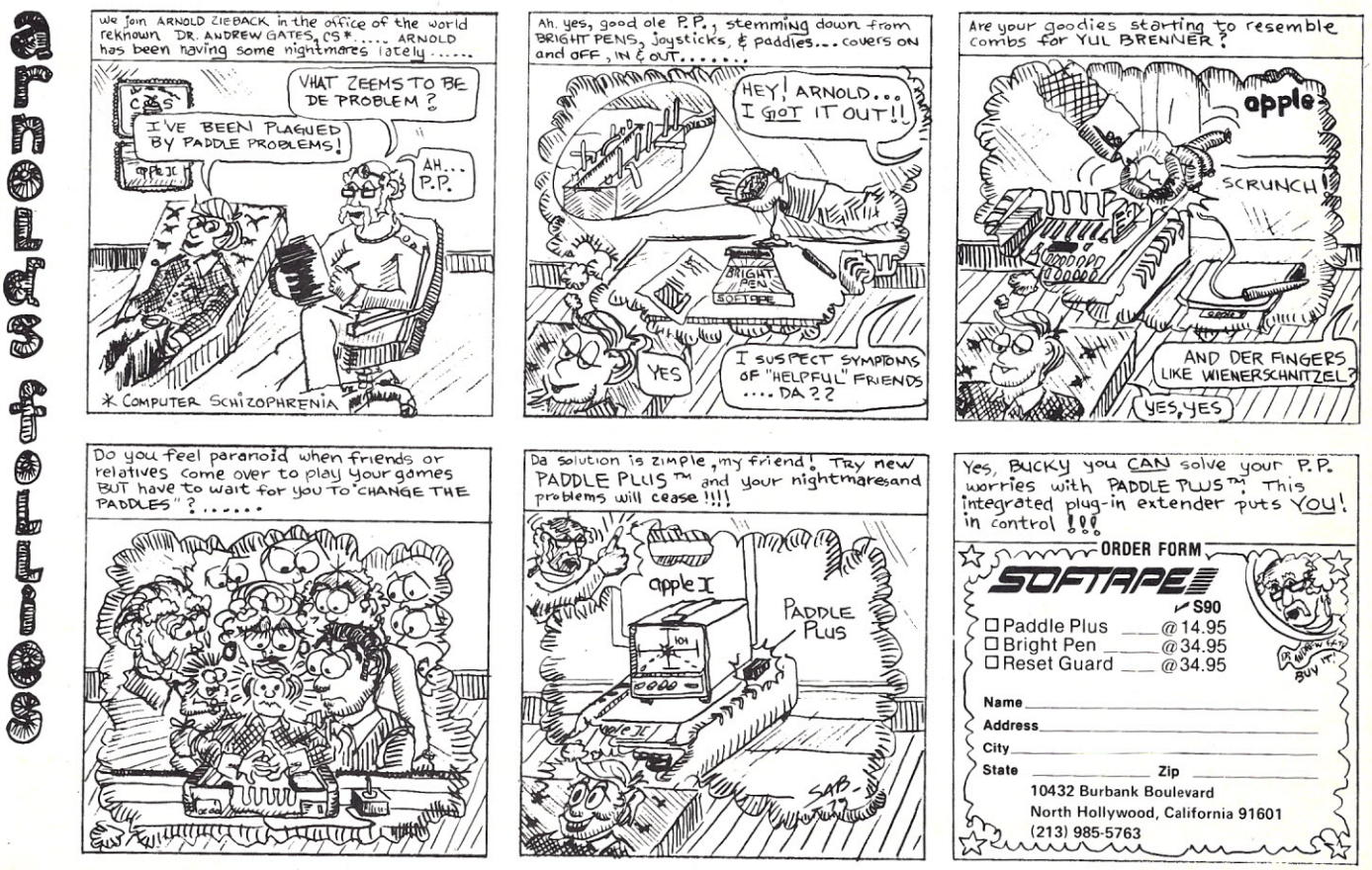
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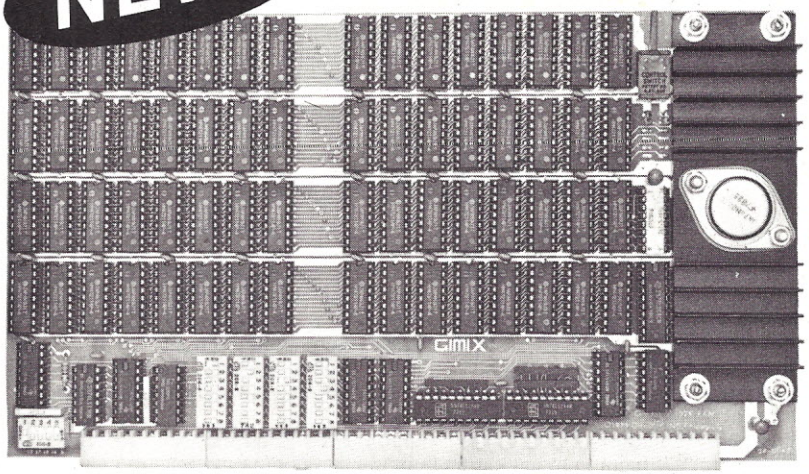
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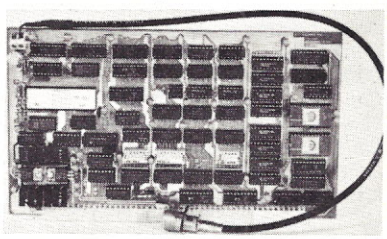
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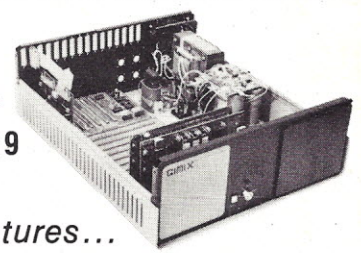
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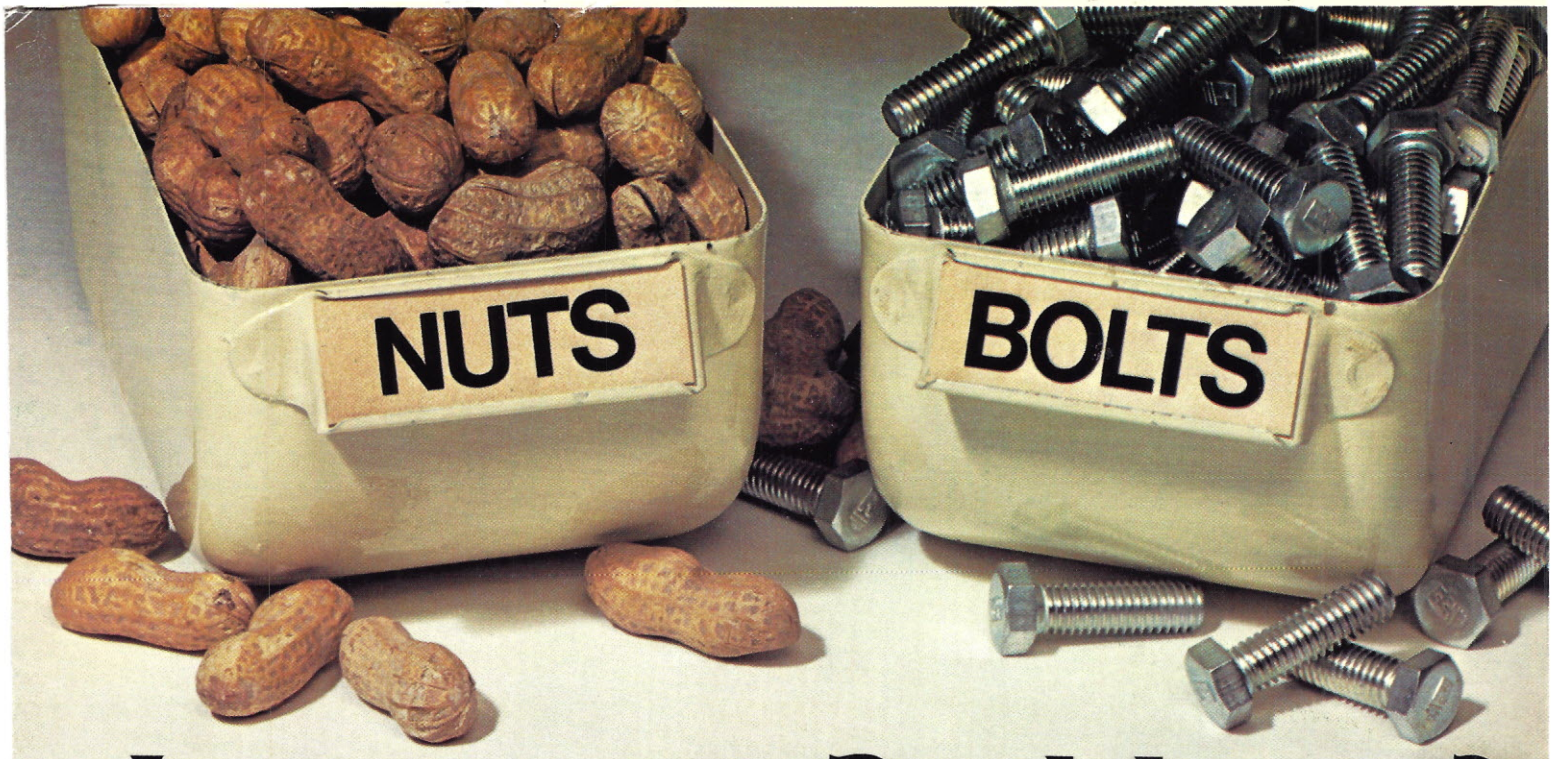
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